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Energy, Minerals and Industry
Washington, D.C. 20460

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March 1977

AN EXPERIMENT IN ZERO-BASE BUDGET ANALYSIS-- FISCAL YEAR 1978

Interagency
Energy-Environment
Research and Development
Program Report

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THE ENERGY/ENVIRONMENT R&D DECISION SERIES

This volume is a part of the Energy/Environment R&D Decision Series. The series presents the key issues and findings of the 17-agency Federal Interagency Energy/Environment Research and Development Program in a format conducive to efficient information transfer. The volumes are of three types: summaries—short synopses of larger research reports; issue papers—concise discussions of major energy/environment technical issues; and executive reports—in-depth discussions of an entire programmatic or technical area.

The Interagency Program was inaugurated in fiscal year 1975. Planned and coordinated by the Environmental Protection Agency (EPA), research projects supported by the program range from the analysis of health and environmental effects of energy systems to the development of environmental control technologies. The works in this series will reflect the full range of program concerns.

The Decision Series is produced for both energy/environment decision-makers and the interested public. If you have any comments or questions please write to Series Editor Richard Laska, Office of Energy, Minerals and Industry, RD-681, U.S. EPA, Washington, D.C. 20460 or call (202) 755-4857. Extra copies are available on request.

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OEMI

FEDERAL BUDGET OFFICE (CBO) REVIEW OF EPA'S INTERAGENCY ENERGY/ENVIRONMENTAL R & D PROGRAM

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16. ABSTRACT

In the summer of 1976, the Senate Appropriations Committee requested that the Congressional Budget Office (CBO) review EPA's Interagency Energy/Environmental R & D Program. Senate interest in understanding the program in detail and the Budget Office's desire to evaluate alternative approaches to budget review resulted in a commitment on the part of the OEMI senior staff to complete a zero-base budgeting (ZBB) analysis of the proposed fiscal year 1978 budget. This review addressed the full spectrum of the Interagency Program from environmental control technology to health and environmental effects of energy use. Due to severe time constraints it did not, however, directly involve the participation of representatives from the other 16 Federal agencies and departments which are involved in the Interagency Program. This report is, understandably, imperfect. It does, however, include the documentation of the ZBB exercise, the Congressional Budget Office review of that documentation, and a short analysis of the OEMI experience in doing the review and a discussion of the use of ZBB in the government R & D perspective.

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R & D PROGRAM

by:

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Congressional Budget Office
The Congress of the United States

and

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
RESEARCH AND DEVELOPMENT

INTRODUCTION

At the request of the Congressional Budget Office, the Environmental Protection Agency's Office of Energy, Minerals, and Industry (OEMI) conducted a "Zero-Base Budgeting" (ZBB) review of the OEMI coordinated Federal Interagency Energy/Environment R&D program for Fiscal Year 1978. This ZBB review produced important insight into the capabilities and problems associated with applying ZBB procedures to Federal research and development efforts. It also provided improved understanding of the program itself--its rationale, products and applications.

Considering the short time frame of the effort (less than two months) and the general lack of familiarity with the ZBB process, our efforts were, at best, an awkward step in a long learning process. However, it is a first step which, we hope, will be of interest to all of those who seek more effective administration of Federal programs.

Stephen J. Gage

Stephen J. Gage
Deputy Assistant Administrator
for Energy, Minerals, and Industry

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IV

SECTION I - OVERVIEW

HISTORY OF THE PROGRAM

In June 1973, the President directed the chairman of the Atomic Energy Commission (AEC) to recommend an integrated energy research and development program for the Nation. The AEC completed its effort in December 1973 and forwarded its recommended program in a report, "The Nation's Energy Future." The report identified five tasks (Energy Conservation, Oil and Gas, Coal, Nuclear Energy, and Advanced Energy Resources) required to support the goal of "Regaining and Maintaining Energy Self-Sufficiency at Minimal Dollar, Environmental, and Social Costs." On the basis of the AEC report, the President's budget for FY-75 requested an appropriation through the budget of the Environmental Protection Agency for a much expanded Federal effort in energy/environment R&D.

In early 1974, the Office of Management and Budget and the Council on Environmental Quality established two interagency working groups to analyze the Federal R&D efforts on Health and Environmental Effects of Energy Use and on Environmental Control Technology for Energy Systems. These working groups were to recommend how the Federal funds, requested through the EPA, could be most effectively allocated to support the Federal energy R&D program.

The Interagency study on Health and Environmental Effects of Energy Use developed a comprehensive research program dealing with the human health and environmental aspects of the Nation's expanded energy program. The "Report of the Interagency Working Group on Health and Environmental Effects of Energy Use," completed in November 1974,

presented an integrated environmental sciences research program for the FY 75-79 period. The working group addressed research needs in five major areas:

- o Pollutant Characterization and Monitoring
- o Environmental Transport Processes
- o Health Effects
- o Ecological Effects
- o Integrated Assessment

Simultaneously, another interagency task force addressed an optimal Federal R&D program in Environmental control technology for energy systems. The task force recommendations, presented in the "Final Report of the Interagency Working Group on Environmental Control Technology for Energy Systems," were based upon analysis of objectives, strategies, and program content in nine program areas:

- | | |
|------------------------------|-------------------------|
| o Energy Resource Extraction | o Nuclear Waste Control |
| o Coal Cleaning | o Thermal Control |
| o Flue Gas Cleaning | o Improved Efficiency |
| o Direct Combustion | o Advanced Systems |
| o Synthetic Fuel | |

EPA Coordination Role

The guidance contained in the two interagency reports formed the basis of an integrated, systematic interagency program in energy/environmental R&D. Seventeen Federal departments and agencies participate in the program. The task of implementing the interagency effort fell

to the Environmental Protection Agency's Office of Energy, Minerals and Industry which is responsible for the proper disbursement, monitoring and control of financial resources within both EPA and the other participating agencies.

The program has been funded at roughly the \$100 million per year level since FY-75, with about 40% of this amount being devoted to health and ecological effects research and about 60% to control technology R&D. The President's FY-78 budget request for the program is \$96.4 million including \$39.2 million for health and ecological effects research and \$57.2 million for control technology R&D.

Since the program's inception in FY-75, there have been continuous efforts to coordinate, evaluate, and modify, where appropriate, the program's many activities. These efforts have ranged from a national symposium covering the entire program (held in Washington, D.C. in February 1976) to detailed project reviews by technical experts. Relative priorities of research projects have been adjusted to reflect a number of factors identified in the reviews: changes in emphasis in the Nation's energy plans, increased awareness of technological or economic problems faced by certain energy sources, new knowledge gained through the research projects, etc. Realistically, the ability to initiate new high priority projects was severely limited in FY-76 and FY-77 because of lower-than-anticipated funding in each of those years. However, vigorous attempts were made to restrict the impact of the reductions on those key research projects being conducted by each of

the participating Federal agencies. In the FY-78 budget, the \$4 million reprogrammed from control technology R&D to health and ecological effects research will provide for the initiation of important "new starts" in the latter area.

The ZBB Experiment

In the summer of 1976, the Senate Appropriations Committee requested the Congressional Budget Office (CBO) to review the Interagency Energy/Environment R&D Program. Senate interest in understanding the program in detail and the Budget Office's desire to evaluate alternative approaches to budget review engendered discussions between EPA and CBO. The result of these discussions was a commitment on the part of the OEMI senior staff to complete a zero-base budgeting (ZBB) analysis of the proposed fiscal year 1978 budget. The desire to provide CBO with the ZBB review in time for them to prepare an issue paper for the Senate appropriations hearings severely constrained the depth and breadth of the analysis. Eight weeks were available for assembling the basic planning information in the ZBB format. The CBO review of this effort is enclosed as Section III.

The ZBB review of the energy control technology R&D subprogram, which is both planned and implemented by OEMI, extensively involved both OEMI headquarters and laboratory staff. The ZBB review of the health and ecological effects research subprogram was conducted by OEMI's Energy Coordination Staff in cooperation with selected project officers in the various EPA laboratories. Because of the limited time available, it was not possible to fully involve all of the participating

agencies in the experiment. Thus, input from the other agencies was primarily derived from the detailed project reviews conducted by OEMI's Energy Coordination Staff within the past six months.

ZBB Perspective

The ZBB process itself is perhaps better understood as a perspective. This perspective is built upon the disciplined, explicit statement of program purpose and utility. Programs are broken down into heirarchical layers. For each layer, the program is divided into a logical set of "decision units." These decision units are chosen without regard to organizational structure but, rather, with emphasis upon the internal cohesiveness, completeness and comprehensibility of the decision unit from an upper management perspective.

Within each decision unit, alternative levels of funding are presented. These alternatives may range from canceling the unit through three or more increments of continued and additonal funding. Each of these increments is accompanied by a concise statement of the benefits to be derived. In the review process, each of the funding increments of each decision unit is ranked by management. Upper management may then review this ranking for concurrence and define the level of future funding knowing what expenditures will purchase. In essence, the ZBB process seeks to define clearly the purpose and payoff of each program and, in the process, provides a historical record of major decisions. Through disciplined program documentation and concise analysis, the ZBB process provides vastly improved program awareness for both

program participants and upper management. It allows the clear identification of priorities and supports well-formed upper management resource allocation decisions. The ZBB perspective also serves as an effective test of management at each layer of the organization. It challenges managers to make explicit their understanding of the goals and purposes of their program within the context of the overall organization. It also provides all parties involved with specific product deadlines and an explicit set of historical data which can be used as performance yardsticks for success. Hence, the criteria here is not simply lower management's familiarity with the technical terms of their own program, but rather their ability to place technical issues in an appropriate management/decision context.

The ZBB format can be most effectively applied to any program where a clear cost/benefit relationship can be defined. This characteristic implies a host of problems for ZBB in the context of a large applied R&D program within a Federal regulatory agency. While it is easy to determine the costs of such a program, it is far more difficult to establish the costs of not conducting, i.e. the benefit of such a program. It is less simple to quantify the benefits to the Nation of research where the entire purpose is to identify the health and environmental cost of a particular pollutant. And it is even more complicated to define a proper split between applied or solution oriented and basic or discipline oriented research. In an applied R&D environment, the payoff from staff and dollar resource expenditures are primarily of three types. Each result is associated with a specific user.

1. Attainment of a discrete event in developing a device, software, or technology pilot demonstration, (e.g. proof of concept, development of full-scale demonstration, commercialization). For such events, alternative resource levels will change the timing of the event and the probability that it will be achieved.

2. Acquisition of data and parameters, (e.g. SO_x atmospheric conversion rates, threshold limits on contractions for health effects, lethal doses). For such data, alternative resource levels will vary the timing and confidence level (accuracy) of the data.

In more basic research there is only one payoff.

3. Improvement in scientific concepts, knowledge of research techniques, (e.g. development of new model concepts and development of method for relating micro-biological tests to health effects).

Problem Definition Research

Perhaps the most difficult aspect of the ZBB process was the attempt to specify the nature of long-term or problem definition research. The R&D process, unlike repetitive manufacturing or routine government service operations, is often difficult if not impossible to plan and schedule with any precision. This is especially true of more basic scientific and technological research. The managers of any large applied research program will always recognize the soundness of more fundamental research and therefore will allocate some resources toward this end. The goal of the applied research process is the orderly generation of new information. If programs are large enough, expenditures

designed to improve the research program per-se will always appear attractive. For example, if an applied research program is designed to document the health effects of specific types of air pollutants, projects designed to develop alternative testing techniques, such as measures of enzyme systems or cellular function inhibition, will always hold promise of providing a more rapid and less expensive method of generating the needed information. Likewise, in a program designed to improve control technologies for a particulate matter in stack gases, program managers must choose between expenditures designed to improve the performance of established technologies versus providing resources for a more fundamental research on the chemical and physical properties of particulates.

THE OEMI REVIEW

The ZBB review of the energy/environment R&D program conducted by EPA divided the Interagency Program into 39 decision units. These units were grouped into three major areas--health and ecological effects, control technology and program integration. Three resource levels were developed for each decision unit and the relative priority of each increment was specified within the three major areas. The documentation for each of the 39 decision packages is enclosed as Section II.

The experience gained in conducting this review has proven to be of considerable benefit to the OEMI program managers. Several substantive insights resulted from the application of ZBB approach to the Federal Interagency Energy/Environmental R&D Program or, more broadly speaking, to R&D programs in general. This initial effort at ZBB review in OEMI has, however, been demanding on staff time. Such a

review is extremely labor intensive; the incremental benefits of the review must be weighed against the additional staff efforts above and beyond the traditional planning and budgeting activities.

The ZBB concept, when applied to R&D programs, encourages the use of supplementary methodologies for establishing the relative priority of decision units. In the review of the energy control technology R&D subprogram, a ranking model was found to be extremely useful. This model included such factors as the expected commercial impact and anticipated environmental problems of the energy system being considered, the status of the applicable control techniques, the probability of achieving pollution control objectives, and the utility to the Agency's standards setting effort. The construction and calibration of such a model yielded a framework which not only facilitated trade-off analysis among various decision units in the subprogram, but also increased confidence in the validity of the trade-offs.

The motivation for long-term research is always the belief on the part of the manager that expenditures will improve the state-of-the-art and thereby improve the accomplishment of an applied research program. Decisions to expand long-term research are controlled by the manager's feeling that advances are likely and that researchers of sufficient quality can be found. Both of these aspects of the motivation for basic research--belief that improvements will result and belief that good researchers are available--are not output oriented. As such, the expected accomplishments of basic research expenditures are extremely difficult to

express, in terms of the specific goals of an applied program. The ZBB tendency to be as quantitative as possible does not neatly mesh with the analysis of more basic research.

The CBO staff comments on drafts of the ZBB analysis confirmed the difficulty of comparing budget increments for research activities of differing degree of direct applicability to research goals. Comparisons of incremental expansions of activities, e.g., monitoring of three versus five stream segments, were relatively simple to display in the ZBB format. However, the relative programmatic importance of toxicology studies of additional pollutants, versus the development of simplified screening tests was considerably more difficult to establish.

Ranking Priorities

In the OEMI experience the major advantage, and perhaps the distinguishing feature, of the ZBB process is that the rank ordering of budgetary increments depends on the explicitly demonstrated program accomplishments. This fact serves to reinforce in the mind of the program managers the importance of the program's output. All too often research program managers become preoccupied with the needs for the research program's input and are vaguely aware of or concerned with the program's actual achievements. This problem is worsened by the long time lapses between resource planning for FY-78 and research publication in FY-80. The OEMI program managers were surprised with the additional insights that they gained from displaying the outputs as a function of resource level. These insights have already led us to make a number of modifications in our detailed plans for FY-78.

Single Year Planning

Another aspect of R&D programs which complicates ZBB reviews is that most projects require more than one year for completion. The R&D projects being conducted under the Interagency Program typically require three to five years. For example, this cycle may start with an initial low investment in laboratory or bench-scale research activity and be followed with increasingly larger investments for design, construction and operation of pilot and full-scale equipment. Progression through all of these steps may be necessary to develop and demonstrate the concept. The demonstration phase can, in itself, require a period of at least three years during which the sponsoring agency may be required to provide funds for constructing and operating the demonstration unit as well as for testing and evaluating the unit after shakedown is completed.

The concept of ZBB appears to focus on an individual fiscal year with little consideration given to the "out-year" consequences of funding--or not funding--a particular decision package. Consideration can be given to this aspect by identifying the fraction of the project which would be achieved with the funding provided by the decision unit resource level. The implications of previous and future funding for R&D programs should, however, be more fully investigated, with an eye toward further refinements in the ZBB methodology for consideration of multi-year projects.

For such multi-year programs, however, the ZBB process can provide a benefit to management. The ZBB format makes clear the threshold nature of major R&D efforts. By explicitly defining both purpose and anticipated

products, the ZBB format identifies those program areas which, although considered important, are so underfunded as to be nonproductive. With this fact made clear, management may then decide either to cancel the program entirely or to increase support of the program to a level which has some promise of useful payoff.

Annual incremental reassessment and reallocation of R&D funding forces R&D managers to place an inordinately high value on projects with highly visible short-term payoffs at the expense of more important longer term objectives. Although ZBB can be misused to sustain this imbalance, it could be used to display program packaging on an integrated multi-year basis. When thus used, ZBB can permit a substantial improvement in R&D efficiency. Once a decision is made, for example, to conduct and complete R&D on a particular coal-cleaning technology, a multi-year R&D decision package would be established. Such a package would define the minimum threshold of a particular decision unit for the entire multi-year span of the effort, and would thus greatly simplify the annual ZBB program review process.

Multi-Agency Reviews

The Interagency Energy/Environment R&D Program employs, to considerable extent, support from specialized technical experts in sixteen other Federal agencies. The budget prioritization process, consequently, affects activities such as program management, manpower and equipment scheduling, and overhead resource allocation in the participating Federal agencies. To assure adequate communications with these other agencies during a

full ZBB review of the Interagency Program, contacts would have to be made with hundreds of personnel. Further, it is not clear how a complete ZBB review would be conducted on an interagency program. For example, how would such a review handle simultaneously the rank ordering of decision units by the organizational hierarchy in the coordinating agency (EPA) and the performing agencies (e.g. ERDA, NOAA, TVA, USGS, etc.)? Another question is how the participating agencies rank the projects carried out under the aegis of the Interagency Program relative to those conducted with their direct appropriations. Such difficulties must be satisfactorily resolved before a comprehensive ZBB review is attempted on an interagency program.

Another major problem in assigning priorities was the wide range of complexity and dollar value associated with the activities. Individual decision increments in the control technology program, for example, makes the comparative ranking of competing decision packages extremely difficult.

Priority Rankings Among Major Areas

This preliminary review of the Interagency Program highlighted the inherent difficulties in using the ZBB approach to manipulate programmatic information effectively enough to allow comparisons at alternate levels of aggregation. The funding increments of the decision packages used in the OEMI exercise typically represented a collection of individual, but related, projects. As such, each of the program managers involved were able to view each funding increment as an entity within one of the three major areas (health/ecological effects, control technology,

program integration). From this perspective, each funding increment could be assigned a priority relative to the other funding increments within that major area. Extreme difficulty was encountered, however, when funding increments within one major area were compared with funding increments within another major area, and such comparisons were not vigorously produced.

This, of course, was not completely consistent with the spirit of ZBB. Two overriding factors, however, dictated this course of action. First, the short time available for the project precluded the devotion of adequate management time to detailed review and cross-comparison of the alternative funding increments. Second, and more fundamental, the disparate yet interconnected activities of the overall Interagency Program were inherently very difficult to rank. For example, the development of an instrument to measure pollutant concentrations in the environment, and the development of control hardware to reduce the release of that pollutant may seem to be separable activities. In some instances, however, the demonstration of the control device will dictate the performance specifications of the required instrument. Hence the program managers found it exceedingly difficult to mold together the three major areas and to rank order the combined list of decisions packages.

OEMI senior staff did, however, undertake the difficult task of ranking health and ecological effects research units relative to control technology R&D units for a limited subset of program decisions units. The example shows the relative ranking of decisions units within a range of \$10 million above and below the \$96.4 million requested in the

President's FY-78 budget. The decision units involved and their relative priority is presented in Section IV. The relative ranking of the funding increments within a range around the nominal level of the total program was considerably easier for two reasons: First, the relationships among the outputs of the several funding increments could be more easily understood. Second, the impact of adding or deleting the outputs associated with those increments could be compared with the impact of higher priority parts of the program. This comparison at the margin is especially important in evaluating budget allocations in a complex inter-related program.

SECTION II - ZBB DECISION UNITS

CONTROL TECHNOLOGY

ZBB DECISION ACTIVITY PRIORITY RANKING
CONTROL TECHNOLOGY

Lowest Budget			First Increment			Additional Increment		
Priority Ranking	Activity	\$1,000	Priority Ranking	Activity		Priority Ranking	Activity	\$1,000
1	NO _x Control	7,895	16	NO _x Control	1,423	29	Fluidized Bed Combustion	714
2	Fine Particles, etc.	5,942	17	Fine Particles, etc.	943	30	Flue Gas Desulfurization	1,631
3	Flue Gas Desulfurization	1,999	18	Flue Gas Desulfurization	1,133	31	Phys./Chem. Coal Cleaning	1,353
4	Solid Fuel Extraction	3,400	19	Solid Fuel Extraction	800	32	NO _x Control	1,500
5	Phys./Chem Coal Cleaning	3,995	20	Fluidized Bed Combustion	2,346	33	Solid Fuel Extraction	1,110
6	Fluidized Bed Combustion	2,951	21	Phys./Chem. Coal Cleaning	332	34	Fine Particles, etc.	1,968
7	Waste-as-Fuel	2,900	22	Waste-as-Fuel	1,200	35	Waste-as-Fuel	900
8	Syn. Fuel (Non-Coal)	1,110	23	Syn. Fuel (Non-Coal)	400	36	Syn. Fuels (Non-Coal)	200
9	Adv. Energy Systems	500	24	Advanced Energy Systems	300	37	Advanced Energy Systems	700
10	Waste & Water Pollution Control	1,675	25	Waste & Water Pollution Control	1,133	38	Syn. Fuels (Coal)	488
11	Syn. Fuels (Coal)	2,743	26	Syn. Fuel (Coal)	1,788	39	Advanced Energy Conversion	200
12	Oil & Gas Extraction	1,700	27	Oil and Gas Extraction	500	40	Advanced Oil Processing	1,318
13	Adv. Oil Processing	1,532	28	Industrial Energy Conservation	300	41	Industrial Energy Conservation	500
14	Adv. Energy Conversion	400						
15	Indus. Energy Conservation	400						
TOTALS		39,142			12,598			12,582

ZBB DECISION ACTIVITIES - CONTROL TECHNOLOGY

	75%		100%		125%	
	\$1,000	RANK	\$1,000 (Δ1)	RANK	\$1,000 (Δ2)	RANK
<u>Energy Resource Extraction</u>						
Solid Fuel	3400	4	800	19	1110	33
Oil and Gas	1700	12	500	27	0	
<u>Physical/Chemical Coal Cleaning</u>	995	5	332	21	1353	31
<u>Flue Gas Cleaning</u>						
Flue Gas Desulfurization	1999	3	1133	18	1631	30
NO _x Control	7895	1	1423	16	1500	32
Fine Particle and Hazardous Material	5942	2	943	17	1968	34
<u>Waste and Water Pollution Control</u>	1675	10	1133	25	0	
<u>Direct Combustion</u>						
Fluidized-Bed Combustion	2951	6	2346	20	714	29
Advanced Oil Processing	1532	13	0		1318	40
<u>Energy Conservation and Advanced Technologies</u>						
Synthetic Fuels (coal)	2743	11	1788	26	488	38
Synthetic Fuels (non-coal)	1110	8	400	23	200	36
Advanced Energy Conversion Cycles	400	14	0		200	39
Advanced Energy Systems	500	9	300	24	700	37
Industrial Energy Conservation	400	15	300	28	500	41
Wastes as Fuel	2900	7	1200	22	900	35
	39142		12598		12582	

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environmental	Control Technology	Energy Resources Extraction	Solid Fossil Fuels

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>		<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
ERDA	\$ 400,000		
EPA (IERL-CI)	3,000,000	\$800,000	\$1,110,000
TOTAL	\$3,400,000	TOTAL \$800,000	TOTAL \$1,110,000

STATEMENT OF PURPOSE

This decision package covers the EPA national program for research, development, and demonstration of pollution control technology for mining, beneficiation and transportation of solid fuels. The various individual areas of investigation involve: 1) Eastern Surface Coal Mines, 2) Eastern Underground Coal Mines, 3) Western Coal Mines, 4) Treatment of Mine Drainage, 5) Oil Shale Mines, 6) Uranium Mines, and 7) Transportation of Solid Fuels. The extraction of Solid Fuels Program is primarily designed to determine potential environmental damages from mining, transportation, and beneficiation processes, to develop treatment and control options to abate air, water and land pollution from these operations, and to demonstrate the feasibility and cost effectiveness of the use of the various environmental control technologies. A corollary objective of the program is to transfer the information developed to the user community (mining companies, State regulatory agencies, EPA Regional offices, ERDA, etc.) through Manuals of Practice, seminars, training programs and technical presentations.

USE OF OUTPUTS

The outputs from the EPA Solid Fuel Extraction R&D Program will be used by:

- Federal (EPA), State and local environmental bodies having regulatory (standards-setting and enforcement) responsibilities to establish practicable and environmentally acceptable standards and guidelines for the rapidly expanding mining industry.
- Mining companies themselves and their consulting engineers and equipment vendors in designing and implementing full-scale applications of the control methods and techniques developed. Data on pollutant identification (particularly of toxic components) and pollutant generation rates will stimulate privately-funded R&D within the mining industry itself to develop cost-effective control approaches.
- Federal and State energy agencies (e.g., ERDA) to aid in establishing their own positions and priorities with regard to the various fuel alternatives under consideration.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$3,400,000)

Rank No. 4

Outputs from this activity include:

- The development of a comprehensive audio-visual instructional package on environmentally protective mining methods to aid in the training of mine inspectors, environmental technicians, mine foremen and mine operators.
- A predictive pollution control model on active mining operations for use as a tool for planning and issuance of permits by State agencies.
- A manual of practice for controlling environmental damage from Eastern surface coal mines.
- A demonstration of the feasibility of stowage of waste materials in closed sections of underground mines to provide a method to prevent acid mine drainage.
- An interim manual of practice (current state-of-the-art) on demonstrated methods for prevention of pollution from active and abandoned Western United States surface and underground coal mines.
- An interim manual of practice (current state-of-the-art) on demonstrated methods of abating pollution from the extraction and handling of oil shale and tar sands.

OUTPUTS FROM THE FIRST INCREMENT (\$800,000)

Rank No. 19

- Assessment of the potential environmental impacts of the mining activities associated with the in-situ retorting of oil shale. This information is essential to EPA, ERDA, Dept. of Interior and private developers of oil shales. ERDA must have such information to intelligently guide its energy development program in regard to oil shale, EPA must have such data to properly set environment standards and guidelines, and Dept. of Interior must have such data to determine the advisability of granting further oil shale leases.
- Assessment of the environmental effects of coal haulage by railroad to allow local, State and Federal authorities to define appropriate regulations, standards and guidelines for this activity.

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,110,000)

Rank No. 33

- An environmental assessment of uranium extraction by the surface mining and in-situ leaching processes, including projections of the effects on surface and subsurface water and on air quality, and a hydrogeochemical model of the effects uranium extraction on ambient groundwater quality in a sandstone aquifer. This information is required by EPA, ERDA, DI, state agencies and private uranium extraction concerns. EPA will utilize this information to set certain environmental standards and guidelines. Department of Interior and state agencies must have this data in order to grant additional mining leases, and ERDA requires this information for input to its energy program concerning uranium.
- A detailed operations manual on environmental protection techniques will be prepared for use by the extraction industry and regulatory personnel. This manual will provide guidance on mining techniques and water and air pollution abatement procedures.
- A surface reclamation technique will be developed for open pit uranium mines and tailings ponds for use by mine operators and regulatory personnel.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Energy Resource Extraction,	Oil and Gas

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>		<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA (IERL-CI)	\$1,700,000	\$500,000	0
TOTAL	\$1,700,000	TOTAL \$500,000	TOTAL 0

STATEMENT OF PURPOSE

The principal objective of the EPA oil and gas production research program is to assure that the recovery of the nation's offshore and onshore oil and gas resources from existing, frontier and ecologically sensitive sites, is conducted in an environmentally acceptable fashion. This is to be done by developing methods, technology and equipment to prevent, control and abate the discharge of environmental pollutants, including those from accidental spills and operational releases from oil and gas exploration, production, storage and transportation facilities. This program will demonstrate and document the technical/operational feasibility and cost/effectiveness of environmental control options and provide effluent control guidelines on a timely basis.

USE OF OUTPUTS

- EPA will utilize program results in setting water quality standards for oil and in development of effluent guidelines for the oil production and transportation industries.
- Federal (EPA and Coast Guard), State and local agencies responsible for oil spill clean-up will use program outputs for the development of their spill contingency plans and equipment purchase programs.
- The petroleum and oil transportation industries will use program results in the design, construction and operation of oil/gas production, transportation and storage facilities.
- International bodies such as IMCO will use program results as U.S. inputs to their standards for the identification, allowable discharge levels and required treatment of oily waste waters.
- The U.S. Geological Survey and the Bureau of Land Management will use program outputs in their offshore site selection/leasing programs and in setting standards for platform installation and facility operation.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$1,700,000)

Rank No. 12

The program will assess the existing and potential adverse environmental impacts (air, land, water) from active and planned oil and gas production, storage and transportation facilities. The R&D will feature the development, evaluation, and assessment of oil spill prevention, cleanup and control equipment and will give special emphasis to the development and demonstration of oil and gas production environmental control technology and practices for use in offshore and onshore facilities.

A summary of the outputs from the Lowest Level Program is:

- Assessment of available control technology and initial development of an improved method to control the environmental impacts from secondary and tertiary recovery programs for onshore oil and gas production facilities.
- Field manuals for 1) describing proper disposal of spill generated debris, 2) using chemical and biological oil spill control agents, 3) determining the extent of contamination and effectiveness of oil spill cleanup operations, and 4) describing the proper techniques for protecting and restoring oil spill contaminated shorelines.
- Specification of operation and maintenance practices and equipment to reduce discharges from offshore oil and gas production facilities.
- Evaluation of off-the-shelf spill cleanup equipment at OHMSETT--EPA's Oil and Hazardous Materials Simulated Environmental Test Tank. Field manuals describing the capabilities of this equipment will be produced.
- Demonstration of a method for environmentally acceptable treatment of bilge and ballast water at shore reception facilities.

OUTPUTS FROM THE FIRST INCREMENT (\$500,000)

Rank No. 27

- An environmentally acceptable pollution control method for the treatment of oily waste discharges from offshore oil and gas production facilities will be selected, evaluated and demonstrated to the prototype scale. This treatment system will be used by the petroleum industry on existing and new production facilities to meet BAT effluent guideline requirements.
- Initial evaluations of alternative oil spill prevention techniques for tank farms will be completed. These techniques will be used by the petroleum industry to meet the Oil Spill Prevention Regulation requirements.
- Five commercial oil spill cleanup systems will be evaluated at OHMSETT. Information from this evaluation will be used by individuals responsible for oil spill response in determining equipment needs.
- Approximately 10 chemical systems for shoreline protection and restoration will be evaluated. These systems will be used by those responsible for oil spill cleanup in responding to spill incidents.

OUTPUT FROM ADDITIONAL INCREMENT (\$0)

Rank No. (None)

No additional outputs will be produced.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Fuel Processing	Physical/Chemical Coal Cleaning

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$3,995,000	TOTAL \$332,000	TOTAL \$1,353,000

STATEMENT OF PURPOSE

The overall purpose of this decision package is to develop means of removing pollution-causing substance from coal prior to its use as fuel, thereby permitting the use of additional quantities of U.S. coal for energy production without adverse environmental effects, and providing an alternate control technology to those sources (area type) that may be restricted either physically or economically from use of flue gas treatment processes. The principal objectives are 1) to determine the extent to which U.S. coals can be cleaned of pollution-causing substances prior to combustion, 2) to develop and demonstrate the technology for removing such substances, 3) to assess the environmental effects of utilizing coal-cleaning technology, and 4) to develop means of controlling such environmental effects within acceptable limits.

USE OF OUTPUTS

Results of environmental assessment of coal cleaning processes will enable federal and state officials to determine the environmental impacts of those processes and to define appropriate emission/effluent/solid waste control and disposal regulations.

Results of coal technology development activities will provide equipment and conceptual design and operational characteristics to designers, manufacturers, and users of coal cleaning technology; also, will provide performance requirements to manufacturers of pollution control equipment.

Results of both the environmental assessment and technology development activities will provide information used by EPA utility sector and state/local pollution control authorities in defining minimal-cost, technically-sound approaches for meeting sulfur emission standards and other pollutant-release regulations.

* Environmental Assessment of Coal Cleaning. Information would be used by: EPA program office, health/ecological effects groups, regional office and enforcement for planning and problem definition; ERDA for environmental impacts, control technology needs and design reviews; and other government/industrial groups for guidance and evaluation.

- Pollutant characterization in waste streams from physical and chemical coal and in dusts and leachates from storage of raw coal, cleaned coal, and process residues using levels 1, 2, and 3 analysis (60%)
- Comprehensive assessments of the environmental impacts of the production and utilization of cleaned coal using IERL/RTP environmental alternatives analysis methodology (50%)
- Development of components of the IERL/RTP environmental assessment methodology (75%)
- Development of manuals of recommended practice for coal cleaning operations produced on a schedule consistent with timetable for standards setting (50%)

* Coal Cleaning Technology/Development/Control Technology Development. Information would be used by EPA to define control capabilities and applicability of process technology for problem solving, by ERDA and industry to define usage and potential environmental effects.

- Amenability of a large variety of U.S. coals to physical or chemical cleaning has been determined in earlier stages of this program. This characterization is continuing with increased emphasis on Western coals (70%)
- Evaluation of the sulfur reduction effectiveness and associated costs of (1) currently available and advanced methods of physical coal cleaning as the pilot and/or commercial scale, and (2) the Meyers (chemical) process on the pilot scale (80%)
- Identification and evaluation of alternative chemical treatment processes (60%)
- Evaluation of the effectiveness of existing control technology and identification of criteria for new technology (90%)

OUTPUTS FROM FIRST INCREMENT (\$332,000)

Rank No. 21

* Evaluate and Develop New Control Technology. Information would be used by EPA for planning and new regulations and by coal users to reduce or eliminate environmental site specific problems.

- Dewatering of fine coal elimination of thermal dryers and energy conservation (brings project to 50% completion)
- Residue evaluation and assess control applicability (brings project to 25% completion)

* Level 1 - Comprehensive Screening

Level 2 - Directed Detailed Analysis Based on Level 1

Level 3 - Process Monitoring on Selected Priority Pollutants Based on Levels 1 and 2

- ° Initiate Combined FGD/Physical Coal Cleaning Demonstration (brings project to 20% completion). This demonstration would impact on regulatory and utilities groups defining an integrated technology which would improve control and reduce control costs. ERDA and FEA would be interested in the potential for utilization of the Eastern high sulfur coal reserves for power generation.

- Evaluation of technical advantages
- Evaluation of superior economics
- Determination of environmental effects

- ° Develop Alternatives to Slurry Pond Disposal (brings project to 50% completion). Information from these studies would be used by EPA regulatory and water planning group to define programs and environmental effects. Technology would be useful to the coal industry as a means of increased recovery of coal and elimination of the slurry pond problem.

- Elimination of slurry pond usage
- Elimination of pond run-off/toxic discharge problems
- Elimination of hazards of dam failures
- Convert slurry discharge into solid discharge; reduction of leakage
- Increase recovery of usable coal

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Flue Gas Cleaning	Flue Gas Desulfurization

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$1,999,000	TOTAL \$1,133,000	TOTAL \$1,631,000

STATEMENT OF PURPOSE

The purpose of the funding described in this decision package is to continue to develop and demonstrate technology which would improve the reliability, performance and economics of flue gas desulfurization systems including first and second generation non-regenerable systems and regenerable systems with marketable by-products. Flue gas desulfurization is the only near term technology enabling compliance with sulfur oxide standards while expanding use of abundant coal supplies, thus meeting environmental and energy goals. The package also addresses comprehensive research and development programs to develop, demonstrate and recommend environmentally acceptable and cost effective techniques for disposal and utilization of flue gas cleaning wastes. The program includes the development and implementation of a strategy to effectively disseminate the associated control technology information.

USE OF OUTPUTS

The FGD development/demonstration data, models and comparisons can be employed by utilities, process and equipment vendors, architects and consulting engineers, plus Federal, state and local environmental bodies having regulatory and advisory responsibilities to determine the desirability (based on cost, reliability, and performance) of various FGD alternatives for a specific situation. The data produced for waste disposal of sludge produced by the demonstrations will be valuable in development of waste handling techniques for various other sources (i.e., particulate, FBC sludge, etc.). Similarly, the waste utilization techniques can be employed in other areas. The demonstration and information transfer programs will also accelerate commercialization of the various FGD systems.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$1,999,000)

RANK NO. 3

- Comprehensive test and evaluation of the Wellman-Lord/Allied FGD demonstration will be completed. This first application of this technology to a utility in the U.S., to a coal-fired utility anywhere in the world, and to by-production of elemental sulfur, the most desirable by-product in the U.S., will demonstrate its viability for compliance with current and projected sulfur oxides standards. (100%)*
- FGD data books, cost and reliability models and comparisons between FGD processes and with alternative technologies will be produced. These outputs will accelerate decision-making with regard to compliance with standards and improve the overall effectiveness of those decisions. (20%)
- The full-scale double alkali demonstration program will be completed. Results from this program will provide a 2nd generation alternative to lime/lime-stone scrubbing having significant energy, reliability, performance, and cost advantages. (100%)
- Comprehensive analyses of FGD wastes and by-products such as sludge and gypsum from nonregenerable FGD systems and sulfur and sulfuric acid from regenerable FGD systems will be produced. This data will indicate the effectiveness and economical acceptability of disposal techniques, and the marketability of regenerable by-products and utilization products. (75%)

OUTPUTS FROM FIRST INCREMENT (\$1,133,000)

RANK NO. 18

- The IERL-RTP in-house FGD pilot plant will be converted to a double alkali configuration for support of the full scale double alkali demonstration program. The pilot plant data will decrease the risk factor associated with full scale demonstration by providing a facility for investigating any problems which may occur during the demonstration program. (100%)
- A pilot/prototype study of double alkali scrubbing using limestone regeneration will be performed to establish designs and operating parameters for optimum utilization of this mode. Limestone (rather than lime) is the preferable mode of regeneration because of the expected cost and energy savings. (50%)
- The test program for the 100 MW demonstration of the aqueous carbonate process will be completed. This relatively simple and inexpensive process is a low energy consumer and produces elemental sulfur, the most desirable by-product, with inexpensive, readily available coal. Commercialization will increase the availability and effectiveness of technology for compliance with sulfur oxide standards. (100%)

*Figures in parenthesis indicate percent completion of project with budgeted funding.

An assessment of the capital/operating costs associated with primary regenerable and non-regenerable systems for a variety of industrial boiler sizes and types will be performed. The assessment along with presently available FGD industrial boiler data will be employed to determine data deficiencies and will provide information for setting of SO₂ standards for industrial boilers. (100%)

A demonstration of combined coal ceaning and FGD technologies for control of sulfur dioxide (SO₂) form a utility power plant will be performed. These technologies, in combination, may enable most cost-effective and applicable regulatory and compliance strategies for meeting SO₂ standards. (The package is cost shared between FGD and coal cleaning and will complete 100 percent of Phase I of a four-phase program.)

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Flue Gas Cleaning	NO _x Control

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$7,895,000	TOTAL \$1,423,000	TOTAL \$1,500,000

STATEMENT OF PURPOSE

The purpose of this decision package is to develop control technologies necessary for the effective abatement of nitrogen oxides (NO_x) and related pollutants generated by combustion processes, and to provide comprehensive environmental assessments and system analyses of these control technologies, evaluating their technical soundness, cost and acceptability relative to environmental quality and energy conservation. This development effort should lead to the demonstration of optimum technology for all combustion sources in support of OAQPS needs and of Agency NO_x/Maximum Stationary Source Technology (MSST) strategy. The principal objectives are: (1) to research and develop combustion modification (CM) technologies for environmentally acceptable and economical abatement of combustion generated emissions from major combustion sources; (2) to assess the environmental impacts and analyze the strategy options of applying the NO_x control technologies; and (3) to identify, develop and assess Flue Gas Treatment (FGT) technology for the post combustion control of emissions from the combustion process particularly NO_x and NO_x in the presence of SO_x. The technologies under consideration will be applicable to both new and existing combustion sources burning conventional and new candidate fuels.

USE OF OUTPUTS

The specific information and combustion data gathered can be used by Federal, state, and local regulatory officials to aid in their development and enforcement of standards for the associated pollutants (criteria (NO_x), trace elements, POM). The data gathered on the NO_x control methods (FGT and CM) can be used by utilities, industries, manufacturers and vendors to develop or optimize their NO_x control programs. The results of the fundamental research will be used to optimize combustion modifications and identify new approaches for a variety of source types.

Brief statements of the outputs for various work areas are as follows:

- Perform Environmental Assessment of Combustion Control Technology
 - characterize performance of CM for NO_x control, evaluating effectiveness, economics, acceptability and potential problems
 - perform systems analysis of various control strategies to assess contribution of CM toward attainment of prescribed ambient NO_x levels
 - generate data on combustion related pollutants, including Levels 1/2* analysis
 - reports and data support EPA and ERDA in environmental/energy planning, policy decisions, and standards setting
 - results assist utilities, industry and equipment manufacturers in early attainment of reduced NO_x emissions (30% completion)
 - Perform Applications Testing of Combustion Control Technology
 - quantify corrosion effects of low NO_x CM on two non-NSPS and one NSPS utility boilers
 - apply comprehensive sampling and analytical system to in-house projects
 - corrosion effects results support EPA's OAQPS standards development
 - data and results identify and define further R&D needs for IERL program planning (90% completion)
 - Develop Combustion Control Technology for Utility and Large Industrial Boilers
 - continue evaluation of full scale optimum coal burner design, with potential for reducing NO_x emissions to 0.3 lb/10⁶ Btu
 - results support EPA's OAQPS in NO_x standards development
 - provide utility/industry users and equipment manufacturers with advanced burner designs offering superior environmental benefits (25% completion)
 - Develop Combustion Control Technology for Small Industrial/Commercial and Residential Systems
 - continue CM development for small watertube, residual oil-fired package and industrial stoker coal-fired boilers
 - field verify performance of an integrated oil-fired residential furnace optimized for pollution control and energy conservation
 - results support EPA's OAQPS in standards setting for small industrial boilers
 - provide EPA & FEA a more energy conserving and environmentally acceptable approach for home heating (an area source for which improved technology has not been available here-to-fore) (25% completion)
-
- * Level 1 - Comprehensive Screening
 - Level 2 - Directed Detailed Analysis Based on Level 1
 - Level 3 - Process Monitoring on Selected Priority Pollutants
Based on Levels 1 and 2

- * Develop Combustion Control Technology for Industrial Process Combustors
 - complete preliminary feasibility study phase of afterburner technology assessment
 - provides IERL with information for program planning relative to hydrocarbon and carbonaceous particulate emissions control technology for industrial applications (100% completion)
- * Develop Combustion Control Technology for Stationary Engines
 - continue development of "dry" CM techniques for utility gas turbines and large bore I.C. engines to minimize NO_x and other combustion related emissions
 - results support EPA's OAQPS in standards setting
 - results identify for equipment manufacturers improved approaches to reduced emissions (15% completion)
- * Develop Combustion Control Technology Based on Advanced Processes
 - continue limited pilot scale development of advanced CM concepts and burner designs
 - investigate use of alternate and future fuels
 - results identify, for EPA's ORD/IERL program planning, technology offering potential for significant improvement in emissions control
 - provides EPA, ERDA, FEA and potential users with data on combustion of alternate fuels and on environmental alternatives (30% completion)
- * Perform Fundamental Combustion Research (FCR)
 - continue low level of FCR, emphasizing chemistry, aerodynamics and modeling relative to reactions of fuel bound nitrogen compounds
 - provides basic understanding to research community of combustion processes as they impact on pollutant formation and control
 - results used by IERL and other researchers (university and industry) to identify improved pollutant control technology for future development (20% completion)
- * Evaluate Flue Gas Treatment (FGT) for NO_x Control
 - identify and evaluate FGT NO_x control technology
 - assess potential requirements for such technology
 - provide inputs to EPA's ORD/OEMI and to Program Offices for planning regarding this alternative control technology for NO_x

OUTPUTS FROM FIRST INCREMENT (\$1,423,000)

Rank No. 16

- * Extend Applications Testing of Combustion Control Technology
 - perform field tests of industrial process combustion equipment for uncontrolled operation and with state-of-the-art combustion controls applied
 - data used by IERL for technology development program definition in industrial combustion equipment area
 - provides EPA's OAQPS with data on state-of-the-art control technology for standards development (20% completion)

- Extend Development of Combustion Control Technology for Small Industrial/Commercial and Residential Systems
 - increase study of effects of fuel/atomization on NO_x control for residual oil-fired package boilers to include engineering design phase^x
 - provides guidance for equipment manufacturers
 - permits earlier demonstration by EPA or ERDA of advanced technology for practical package boiler designs (40% completion)
- Expand Development of Combustion Control Technology Based on Advanced Processes
 - establish a catalytic combustor research program
 - results, if successful, would lead to a low NO_x combustion alternative for area sources for consideration in energy/environmental policy and strategy planning for the future by ERDA and EPA (40% completion)
- Extend Fundamental Combustion Research
 - increase to include additional studies on other primary and secondary pollutants (sulfates, organics, etc.) of potential hazard to health and welfare
 - results used by IERL and other researchers in developing improved control technologies (22% completion)

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,500,000)

Rank No. 32

- Expand Development of Combustion Control Technology for Utility and Large Industrial Boilers
 - perform long term tests of the effect of CM on corrosion for 3 types of NSPS utility boilers, quantifying corrosion rates with respect to the type and degree of CM.
 - data firmly supports EPA's OAQPS revised NO_x standards development
 - results identify for EPA, utilities and equipment manufacturers any potential problems associated with use of CM technology (20% completion)

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Flue Gas Cleaning	Fine Particle and Hazardous Material

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$5,942,000	\$943,000	\$1,968,000

STATEMENT OF PURPOSE

The purpose of this decision package is to develop and demonstrate control technologies (e.g., devices such as: electrostatic precipitators, scrubbers, filters, cyclones) capable of effectively removing large fractions of particulate and fine particulate matter produced in the combustion of fuels or other industrial processes. Particulate removal will reduce what would otherwise be released to the atmosphere to the detriment of human health and ecology, and in the case of hot gas cleanup, what might otherwise damage process equipment. Development includes efficiency improvement of conventional removal devices which would be required if more stringent standards are to be imposed, application technology for special fuels or industrial processes, and hot gas cleanup necessary for operation of advanced energy systems.

In addition, in the area of hazardous materials control, an assessment will be performed describing the character of combustion pollution emissions from a wide range of combustion sources. Data are to be obtained by field sampling, only when available by other means, and of sufficient importance to justify the effort.

USE OF OUTPUTS

Developments will have direct application to the utility and other industries requiring combustion of fuels or other processes producing particulate laden gaseous emissions. Devices capable of operation at elevated temperature and pressure will offer environmental protection and have special application to the cleanup required for protection of equipment (e.g., turbines) used in advanced energy systems such as coal gasification. Improved collection efficiencies and newly developed devices for processes presently lacking effective particulate control will provide the basis for New Source Performance Standards and will impact on Ambient Air Quality Standards in the many Air Quality Regions currently failing to meet suspended particulate standards.

The output from the assessment of combustion systems will be used as a statistical data base for developing control strategies. Knowledge of the pollution contribution of representative sources may be projected to estimate total emissions resulting from implementation of different abatement options. These estimates will be an input to establishing priorities for control technology development; determining the "environmental concepts" that can be expected from control of specific pollution sources; and what effects may be anticipated from resulting emission.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$5,942,000)

Rank No. 2

- Demonstration of a baghouse on a 15 MW coal fired industrial boiler will be completed to provide technology for setting NSPS for coal fired industrial boilers. (100%)*
- Demonstration testing of a baghouse on a 350 MW utility boiler, firing low sulfur coal, will be conducted. A successful demonstration will offer an environmentally sound and economical particulate control alternative for meeting current and future standards when using low sulfur western coal. (60%)
- An improved electrostatic precipitator (ESP) for use on low sulfur coal will be piloted to demonstrate technical feasibility. Completion of this work will provide an economical and reliable means of controlling particulate emissions from burning low sulfur-high ash resistivity coal. (50%)
- The potential environmental impact of many currently available flue gas conditioning agents will be assessed, and an environmentally acceptable flue gas conditioning agent for improving the performance of ESPs will be developed. This project will provide EPA with basis for decisions concerning the use of low sulfur coal as a current alternative to SO₂ scrubbing, and will allow utilities when switching to low sulfur coal to use existing ESPs, thus avoiding very expensive retrofits. (80%, 100%)
- Three mobile particulate control units--an ESP, a scrubber and a baghouse--will be used for field tests of the particulate control difficulty anticipated for selected, priority industrial sources, and as a basis for recommending the most suitable collection device.
- The development of improved fabrics, aimed at expanding the operating range and capability of baghouses for fine particulate control, will continue. This work will have an impact on the potential application of fabric filters, the most efficient of the conventional collectors, to a broad variety of industries to meet current and future standards.
- A comprehensive, multimedia emissions characterizations and source assessment of 56 important combustion source categories will be conducted. Sources will include priority utility, industrial, commercial and residential combustion systems. Results will be used by EPA to examine regulatory strategies and standards options and to prioritize control technology needs. (60%)
- An environmental assessment of conventional stationary combustion sources will be performed aimed at estimating control costs and multimedia pollutant residuals resulting from use of best current and projected control techniques and disposal options. (30%)

OUTPUTS FROM FIRST INCREMENT (\$943,000)

Rank No. 17

- The most promising high temperature, high pressure particulate control technology will be demonstrated at a pilot scale. This technology must be proven and developed

* Figure in parenthesis indicates percent completion of project with budgeted funding.

to commercial scale before advanced energy processes such as FBC, CAFBC, and those using synthetic fuels can be successfully commercialized. (30%)

- New particulate control concepts associated with electrostatic enhancement of fabric filters and device oriented control of fugitive emissions will be investigated. The enhancement of filters will offer more efficient fine particle control at a considerable energy savings, and the development of devices to control fugitive emissions will aid in the setting of standards and implementation of control techniques for this currently uncontrolled source of particulate matter. (100%, 30%)
- Fine particle control technology transfer conferences will be organized and sponsored to inform the user sector of the results of EPA's ongoing R&D program and to encourage the use of the most modern and efficient control methods. (100%)

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,968,000)

Rank No. 34

- The full-scale baghouse demonstration for dry control of particulate emissions from a 350 MW boiler firing low sulfur western coal will be expanded to include the dry control of SO_x by sorbent injection. Successful demonstration will provide a dry method of simultaneously controlling both SO_x and particulate emissions, will reduce greatly the problems associated with the disposal of sludge from SO_x scrubbers, and will give the western utilities a method for utilizing western sulfur coal while still meeting the very stringent local state standards for SO_x and particulate. (50%)
- A comparative, multi-media environmental assessment for two exemplary utility boilers (incorporating best currently available environmental control technology combinations)--one firing a typical eastern coal and the other residual oil--will be made. Results will permit an environmental comparison of controlled and uncontrolled pollutant residuals for these two important combustion categories. (80%)

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Waste and Water Control	Waste and Water Pollution Control

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$1,675,000	\$1,133,000	

STATEMENT OF PURPOSE

The purpose of this decision package is to evaluate, develop, and demonstrate control technologies for minimizing or eliminating the adverse environmental effects of solid wastes and liquid discharges from power plants, including the effects of cooling systems. These technologies include chemical treatment (and other methods for disposal or utilization) of flue gas cleaning wastes (scrubber sludge and coal ash) to prevent contamination of surface and ground waters through run-off and leaching caused by rainfall; increased recycle and reuse of water to minimize consumption, thereby also minimizing or eliminating discharges; advanced treatment methods of waste streams where discharges are necessary; and advanced cooling systems such as dry cooling towers to minimize cooling water consumption in areas where water is scarce or expensive. Development/demonstration of these technologies will serve to support current SO₂/particulate regulations, current and future effluent guidelines, and future solid waste regulations. In addition, these technologies will support the growth of coal-produced energy in an environmentally acceptable manner.

USE OF OUTPUTS

Developments under this activity will have direct application to the electric utility industry and other industries which use fossil fuels to generate large quantities of energy. Flue gas cleaning waste disposal/utilization efforts will provide a variety of options so that the most

cost-effective approach, for a specific plant site, can be taken to prevent water pollution caused by disposal of these wastes. This will allow plants to meet New Source Performance Standards and will support attainment of Ambient Air Quality Standards for SO₂ and particulates in a manner which will avoid secondary pollution effects. Water recycle/reuse and effluent treatment efforts will also provide a variety of options so that the most cost-effective approach can be taken to minimizing water consumption and effluent discharges. This will allow plants to meet current Effluent Guidelines as well as providing technology for establishment of future guidelines. Advanced cooling systems efforts will be aimed at: dry (non-evaporative) cooling systems to eliminate cooling water consumption and other effects such as cooling tower drift (fogging); and prevention of entrapment of fish and other aquatic life in cooling water intake structures.

Developments under this activity will serve as a data base for Federal, state, and local groups who regulate or advise industry in environmental and land use matters.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET

(\$1,675,000)

Rank No. 10

- Evaluation of commercially available, environmentally acceptable methods for disposal and utilization of flue gas cleaning wastes will continue and be completed in support of air pollution and solid waste regulations.
- Pilot demonstration of FGD waste disposal in a coal mine will be conducted to provide an alternative to on-site disposal for power plants which lack land for waste disposal (co-funded). (45%)*
- Pilot studies to improve FGD waste solids will be completed to provide a reduction in the volume of waste generated by FGD systems, thereby also reducing the water pollution potential of these wastes. (100%)
- Long-term weathering studies of chemically treated FGD wastes will be conducted to insure that no future environmental problems will be encountered from disposal of these wastes. (50%)
- Pilot demonstration of reclamation (revegetation) of an FGD waste disposal site will be completed to demonstrate proper disposal techniques for FGD waste. (100%)
- Studies for marketing of FGD by-products will be completed to provide a firm economic basis for utilization of these waste products, thereby avoiding potential pollution effects of their disposal. (100%)

*Figure in parenthesis indicates percent completion of project with projected funding.

- Pilot demonstration of water recycle/reuse techniques will be conducted at an actual power plant to minimize water consumption and prevent unnecessary discharges. (50%)*
- Development of a magnesium carbonate water treatment process will be completed to provide an effective inexpensive method for reducing suspended solids, silica, and hardness in cooling tower make-up water, thereby allowing the use of lower quality water. (100%)
- Pilot demonstration of alternatives to chlorination for cooling system biofouling control will be initiated to eliminate the potential environmental effects of chlorine discharges. (10%)
- Pilot demonstration of membrane technology for treatment of various power plant effluent streams will be conducted to minimize chemical discharges and allow plants to meet effluent guidelines. (40%)

OUTPUTS FROM FIRST INCREMENT

(\$1,133,000)

Rank No. 25

- Pilot demonstration of FGD waste disposal in a coal mine will be expanded to include a comparison of the environmental effects and economics of untreated versus chemically treated wastes (co-funded program). (65%)
- Pilot demonstration of advanced techniques for dewatering FGD wastes to reduce the volume of wastes generated will be completed. (100%)
- Case studies of site-specific factors to evolve a design approach for disposal of flue gas cleaning wastes will be initiated so that the best disposal method for a specific plant can be selected. (20%)
- Pilot demonstration of water recycle/reuse techniques will be expanded to include the examination of additional options so that closer to optimum integrated water use arrangement can be determined. (65%)
- Pilot demonstration of alternatives to chlorination for cooling system biofouling control will be expanded to two techniques (rather than a single approach); this should enhance the opportunity for establishment of several options. (20%)
- Evaluation of ammonia as an intermediate fluid in the cooling circuit in a dry cooling tower will be initiated to enhance the use of dry cooling systems in water-scarce areas (co-funded program). (30%)

*Figure in parenthesis indicates percent completion of project with projected funding.

- Development of a porous dike intake structure for cooling systems will be initiated to reduce fish entrapment and entrainment of larvae and post-larvae, reducing the environmental impact of cooling systems (co-funded program). (25%)*
- Studies of waste heat utilization in future energy systems will be initiated to reduce environmental effects of thermal discharges and promote energy conservation. (25%)

*Figure in parenthesis indicates percent completion of project with projected funding.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Direct Combustion	Fluidized Bed Combustion

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$2,951,000	TOTAL \$2,346,000	TOTAL \$714,000

STATEMENT OF PURPOSE

The purpose of this decision package is two-fold; 1) to continue with the characterization of the air and water pollution, solid residues and other environmental problems associated with atmospheric and pressurized FBC processes thereby establishing environmental goals for the Fluidized Bed Combustion processes and 2) to continue to develop at laboratory and bench scale the control technology necessary for adequate control of all the indicated pollutants, with consideration given to all media for all variations of the FBC processes.

USE OF OUTPUTS

Outputs of this decision package will be used by EPA to independently assess the environmental impact of the FBC processes to establish appropriate data base for environmental standards development and best multimedia control practice for the processes, and to carry out a program to develop the necessary control technology. The control technology developed in this decision package will be applied by all users of FBC systems, thus ensuring that the systems operate in an environmentally acceptable manner.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$2,951,000)

Rank No. 6

- * Comprehensive Analysis of Emissions which will Identify Significant Environmental Problems (15%). Results will be used by IERL to compare with independently-derived environmental goals (based upon health/ecological effects) for the process; this comparison will enable definition of derived control technology development program. Will also be used within EPA to identify those compounds for which additional health/ecological effects data and analytical techniques are necessary. Will identify whether process involves environmental hazard not previously recognized. Are necessary data base to enable recommendation of environmental standards.

- ° Complete Design of an Environmental Testing Program which can be Implemented on the Earliest Demonstration Program Sponsored by ERDA (60%). Data from this designed test program will provide IERL with an important part of the data base necessary to recommend standards for atmospheric FBC, to develop manuals of best available technology, to plan future program requirements, and to lay the groundwork for policy. The data will also provide independent environmental review of ERDA's FBC technology development program.
- ° Interim Emission Goals will be Established and Preliminary Recommendations for Emission Standards for Atmospheric FBC Systems (90%). This information will be used by EPA's Program Offices to develop environmental standards; this output is a key purpose of the IERL program. The emission goals will be used by IERL to plan their control technology program.
- ° Laboratory and Bench Scale Units will be Operated to Develop Best Available Control Technology Recommendations for Atmospheric FBC (25%). The results can be used by IERL in recommending large-scale testing on ERDA units to confirm best available control technology. Once the technology is confirmed on larger scale, it can be used by EPA enforcement personnel and by industry users/suppliers.
- ° Recommendation will be Provided on the Best Available Control Technology for Atmospheric FBC Systems and Documented in Manual Form (90%). This crucial information can be used by: EPA program offices in developing standards; EPA enforcement personnel in enforcing standards; ERDA in assessing the combustion technology that they are developing; and users/process developers/control technology developers/suppliers in industry.

OUTPUTS FROM FIRST INCREMENT (\$2,346,000)

Rank No. 20

- ° Develop Control Technology for Pressurized Fluid Bed Combustion. The results can be used by IERL in recommending large-scale testing on ERDA units to confirm best available control technology for pressurized systems. The results will provide initial guidance to ERDA and industry concerning likely control requirements.

OUTPUTS FROM ADDITIONAL INCREMENT (\$714,000)

Rank No. 29

- ° Accelerate Environmental Assessment of Atmospheric FBC Systems. Results will be used by IERL to compare (on an accelerated basis) comprehensive emissions data with health/ecological effects goals, thus identifying the environmental impact of the process and control needs. Results will also expand the data base needed by the program offices for standards setting.
- ° Accelerate Control Technology Development of Atmospheric FBC Systems. Will accelerate acquisition of data needed by: EPA program offices in developing standards; EPA enforcement personnel in enforcing standards; ERDA in assessing the combustion technology that they are developing; and users/process developers/control technology suppliers in industry.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Direct Combustion	Advanced Oil Processing

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$1,532,000	TOTAL 0	TOTAL \$1,318,000

STATEMENT OF PURPOSE

The purpose of this decision package is to 1) define processing/utilization options for residual oil which minimize multimedia environmental insult and identify related problem areas and 2) develop and demonstrate on a small commercial scale, a chemically active fluidized bed fuel cleanup process capable of utilizing residual fuel oils as well as other solid fuels which are now difficult or impossible to utilize in an environmentally acceptable manner. The package is composed of an environmental and economic assessment, pre-demonstration engineering and technical support, demonstration unit design, installation and operation, and engineering analysis of demonstration results. All of these elements will be integrated in support of a program aimed at residual oil utilization environmental guidelines.

USE OF OUTPUTS

The data resulting from this package will allow the identification of potential environmental problems resulting from process operation and provide information on potential solutions to these problems. Such information is necessary to the development of environmental standards for the operation of this source category. The information can be used to devise and refine monitoring techniques, determine the adequacy of existing techniques for effluent control, and identify requirements for development of new or modified control technologies. The design and operation data can also be utilized in the design of retrofit systems for current users who must abandon or reduce their use of conventional gaseous fuels but who desire to maintain their existing equipment. The data will substantially reduce the risk in the design of such equipment to both the vendor and the user, and thus increase the acceptability of such a process in the commercial market.

- Definition of Key Existing and Projected Processing/Utilization Options for Residual Oil and the Preliminary Environmental Assessment of Problems and Advantages Associated with These Options (60%). EPA, NIOSH, the Administration, Congress, and environmental groups will be able to evaluate the environmental alternatives and control options using the information developed in the output. Industry, both process developers and control technology developers, will be given a clearer picture of the challenges and opportunities facing them.
- Initiation of the Characterization of Available Residual Fuels in Terms of Types, Quantities, and Associated Chemical and Biological Hazards (30%). The health and ecological groups in EPA will use this output, in the form of samples and information to perform source characterization, evaluate test facilities and satisfy ecological testing needs, and pollutant effects data needs. The EPA groups in the environmental sciences area will use this output to define analytical needs, perform pollutant transport/transformation studies and evaluate test facilities using the samples for cross checks.
- Completion of Pre-Demonstration Testing and Development of a Test Program for the Chemically Active Fluid Bed Process (CAFB) (100%). NIOSH will use this output for information on the process and like processes. The samples collected (and the evaluation) will provide much data to NIOSH while relieving them of much of data acquisition burden.
- Post-Demonstration Engineering Analysis and Development of Detailed Operating Procedures for CAFB (90%). The EPA program offices will use this output for problem definition, control and disposal alternatives evaluation and for cost input to the standards setting process. This output will also give a basis for policy and planning activities in EPA. The Regional offices will derive information on problems and control options on a multimedia basis. Technical assistance to the regions is also included in this output.
- Preparation of Specific Reports:
 - Alternatives for Solid Effluent Control (70%)
 - Criteria for Disposal of Solid Effluents (70%)
 - Alternatives for Control of Water Effluents (70%)
 - Alternatives for Control of Air Effluents (70%)
 - Final Report on Process Design, Operation and Engineering Analysis (70%)

These reports will provide information to the general public on the problems and control technology. The EPA program offices will use these reports for problem definition, the development and definition of control and disposal options and to give cost input to the standards setting procedure.

OUTPUTS FROM FIRST INCREMENT (\$0)

Rank No. (None)

Same as lowest budget.

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,318,000)

Rank No. 40

- ° Perform Levels 1 and 2* Environmental Assessment Sampling and Analysis for Major Residual Oil Processing/Utilization Technologies to Provide Basic Environmental Data on Process Operation (Will bring the project to 75% completion.) The EPA health and ecological effects groups will obtain samples from this output and will also receive input to aid them in source characterization, determining ecological testing needs, and in assessing the adequacy of their test facilities. The state and local regulatory agencies can use this output for a clearer picture of the multimedia integration of industry environmental considerations. The industrial process developers can use this output for a better definition of the requirements of and opportunities open to their processes.
- ° Perform Optimization of the CAFE Demonstration Process for Residual Oil, Lignite and other Coals in Order to Reduce Overall Risk in Design of Future Units and thus Increase the Commercial Acceptability of the Technology (Bring to 75% completion). Industry will benefit from this output. All segments will be able to judge what opportunities are open to them for supplying equipment, fuel, service, or for adopting this process to meet their energy/environmental requirements.

* Level 1 - Comprehensive Screening

Level 2 - Directed Detailed Analysis Based on Level 1

Level 3 - Process Monitoring on Selected Priority Pollutants Based on Levels 1 and 2

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Energy Conservation and Advanced Technologies	Synthetic Fuels (Coal)

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 MINIMUM BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
TOTAL \$2,743,000	TOTAL \$1,788,000	TOTAL \$488,000

STATEMENT OF PURPOSE

The purpose of this decision package is two-fold; 1) to characterize the environmental problems associated with processes for converting fossil fuels into cleaner fuels and to assess alternatives for reducing any negative environmental impact or enhancing any positive impacts, and 2) to develop, evaluate and demonstrate environmentally sound control technology applicable to fuel treatment processing and converter output streams, products and by-product streams from fuel conversion/fuel utilization streams, system waste utilization and disposal streams, coal preparation and feeding streams, and wastewater treatment streams.

USE OF OUTPUTS

Outputs of this decision package will be used by EPA on an independent basis for environmental evaluations and identification of best multi-media control practices. Outputs will also be used by process and equipment developers, by process owners or users, and by regulatory agencies and other interested parties in programs to establish appropriate environmental standards for synthetic fuel processes, and in programs to apply the control technology necessary to ensure that the systems operate in an environmentally acceptable manner.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$2,743,000)

Rank No. 11

- * Characterization of Environmental Problems Associated with Low-BTU and High-BTU Gasification and Liquefaction Processes.
The output will be used by EPA's health and ecological groups and by IERL for determining their program emphasis, by integrated assessment contracts as needed input; by regulatory agencies (local, state and federal), by ERDA for process development guidelines, by environmental groups for public awareness and by industry in selection of alternatives.

- Initial reports on chemical, physical, and biological screening tests on laboratory, bench-scale, pilot plant and commercial scale - Levels 1/2* (75%)

* Level 1 - Comprehensive Screening

Level 2 - Directed Detailed Analysis Based on Level 1

Level 3 - Process Monitoring on Selected Priority Pollutants Based on Levels 1 and 2

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- Environmental alternatives analysis initiated (20%)
- Review of available environmental impact statements for the synthetic fuels commercialization program and for various specific synthetic fuels demonstration program (100%)
- Initiate research data base for multimedia standards development and review any guidelines, regulations and standards development by the program official (30%)
- ° Evaluate Existing Technology-Transferrable Control Options (60%). The output will be used by EPA for standards setting, enforcement and program direction, by ERDA for process development and by industry for satisfying regulations and for process development.
 - Identify best options
 - Identify control development needs

OUTPUTS FROM FIRST INCREMENT (\$1,788,000)

Rank No. 26

- ° Increase Environmental Assessment Program for High BTU Gasification Process (will bring project to 25% completion). The incremental output will be used by regulatory agencies to address the new technologies, by environmental effects groups to determine differences from older technology and by development groups to ascertain the relative advantages or disadvantages of the technology and its merit of pursuit.
- ° Initiate New Control Evaluation, Development for Gas Treatment (bring to 10% completion). The incremental output will be used by EPA to have controls available for attainment or improvement of ambient air quality, by EPA to protect the public health and welfare, by industry to seed their development of needed controls, and by regulatory agencies as options; e.g., tradeoffs on prevention of significant deterioration.
- ° Initiate New Control Evaluation/Development for Water and Solids Waste Treatment (brings to 10% completion). The incremental output will be used by regulatory agencies to establish more cost effective alternatives, by health and ecological groups especially in long term and water effects.
- ° Initiate New Control Evaluation/Development for Product/By-Product Treatment (brings to 10% completion). The incremental output will be used by regulatory agencies, by industry to allow utilization of otherwise unacceptable materials, by industry as seed to indicate the benefits of private process control development, and by ERDA for decision making by evaluation of marketability of by-products which would affect the main product's competitiveness.

OUTPUTS FROM ADDITIONAL INCREMENT (\$488,000)

Rank No. 38

- ° Increase Bench-Scale Generic Control Process Evaluation in Support of Standards Development (brings to 10% completion). The incremental output would be used by regulatory agencies, by EPA and other groups for determining environmental and worker effects, and by ERDA and private industry as a data base for needed control development.

- Increase carbonyl sulfide and organic sulfur development at existing gas treatment test facility
 - Initiate design/construction of a solids treatment test facility
 - Initiate design and experimental program for Fischer Tropsch indirect liquefaction test facility
- * Provide Pilot Scale Evaluation Support for Direct Stretford Sulfur Control/Water Treatment for Fixed Bed Low Btu Gasifier (Morgantown) (brings to 50% completion). The incremental output would be used by EPA and other regulatory agencies, by ERDA for process evaluation, by industry for guidance in implementing the technology, and by health effects and assessment groups to provide input for better quality and more statistically significant results.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Fuel Processing	Synthetic Fuels/ Non-Coal

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA (IERL-CI) \$1,110,000	\$400,000	\$200,000
TOTAL \$1,110,000	TOTAL \$400,000	TOTAL \$200,000

STATEMENT OF PURPOSE

Various non-coal based synthetic fuel processes are under development. The environmental and health effects of producing and utilizing synthetic fuels from oil shale, biomass, etc., are not thoroughly understood. This activity will identify the probable environmental effects of such processes and then develop and demonstrate pollution control technology to allow appropriate environmental standards to be written, adequate pollution control methods to be specified, and commercialization of synthetic fuel processes to proceed at a maximum rate. The program will also develop the necessary methodology and technical data base on processes to assist regulatory authorities in monitoring emerging energy commercialization activities. The program will facilitate development of environmental protection technology, concurrent with process development, to accelerate commercialization.

USE OF OUTPUTS

Research results will be utilized by:

- Industries and utilities in developing design and operational specifications for utilization of synthetic fuels.
- Equipment designers and manufacturers in developing equipment to control pollution from production of synthetic fuels.
- Federal, State and local authorities in setting standards and developing guidelines for production and utilization of synthetic fuels from non-coal sources.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$1,110,000)

Rank No. 8

- Pollution control methods and devices will be tested on pilot-scale retorting of oil shale at:
 - Paraho (Anvil Points, Colorado) - surface retorting
 - ERDA or Occidental - in-situ retorting
- An assessment of the best available control technologies for the emerging oil shale industry will be completed.
- An Analytical Methods Manual for expected pollutants from the syn-fuel industry will be prepared.
- Analytical reports on non-coal synthetic fuel pollutant emissions and control technology assessment will be prepared for:
 - Preliminary Environmental Assessment of a Hydrogen Economy
 - Macro-Economic and Macro-Environmental Study of Biomass Fuel vs. Coal

OUTPUTS FROM THE FIRST INCREMENT (\$400,000)

Rank No. 23

- Will extend pollution control technology testing to include Union or Tosco II pilot plants in addition to those listed under the first item in Description of Outputs for Lowest Budget.

OUTPUT FROM ADDITIONAL INCREMENT (\$200,000)

Rank No. 36

- Will provide evaluation of the environmental impacts of both the Union Oil and Tosco II processes for oil shale.
 - Will produce a Manual of Practice on best available pollution control technologies for the synthetic fuel (non-coal) industries. This will be used by regulatory agencies to set standards and by individual companies to design pollution control equipment.
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<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Energy Conservation & Advanced Energy Technology	Advanced Energy Conversion Cycles

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA \$400,000	0	\$200,000

STATEMENT OF PURPOSE

Advanced power systems such as high temperature turbines, magnetohydrodynamics, fuel cells, etc. are more efficient than conventional systems. Every percent increase in average efficiency of electric power generation results in large reductions of pollutants generated per unit of power produced. In some respects, then, these more efficient systems can be considered as pollution control alternatives to conventional systems. This program will assess the projected environmental impacts of advanced energy conversion technologies for electric power generation and will assure the development and evaluation of control systems for problem effluents from these technologies. This, in turn, will allow pollution controls to be designed into advanced power systems from the start and will allow realistic environmental regulations and standards to be formulated. Using the results of this program, EPA, in cooperation with other agencies such as ERDA, will not only be able to anticipate and provide for solution of environmental problems but will also, where predictions of efficiency and environmental benefit warrant, encourage development and commercialization of the more environmentally advantageous advanced power systems.

USE OF OUTPUTS

- Results will be used by Federal and State regulatory offices to establish practical and environmentally acceptable standards and guidelines for the developing advanced power cycle industry.
- Effluents identified as potentially toxic will be "flagged" for investigation of health effects, need to control, inclusion in NSPS, etc.
- Results will be used by designers of advanced systems to identify effluents for which new or improved controls must be developed. Models will be utilized to predict effects on cycle efficiencies and outputs of adding or changing pollutant control systems.

Companies and organizations using environmental assessment data from the advanced cycle analyses as inputs for power plant designs, pollutant control system research and development, and formulation of guidelines and regulations include:

1. US ERDA and their contractors.
2. US EPA regulatory and enforcement programs.
3. State and local environmental control agencies.
4. Commercial power plant and component designers and builders.
5. Privately owned electric utilities and TVA.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$400,000)

Rank No. 14

A major environmental assessment began 4/76 and is scheduled for completion 4/79. This study requires incremental funding in FY78. Outputs from this assessment will include:

- Identification and quantification of projected gaseous, liquid, and solid effluents from advanced energy conversion cycles that use coal or coal-derived fuels.
- Evaluation of expected performance of pollution control systems known to be applicable to these kinds of waste streams.
- Identification of pollutants for which new control systems need to be developed or for which further research on environmental transport, fate, or effects is needed.
- Comparisons of candidate cycles with regard to both efficiency and environmental impact.

Involvement is also planned for FY78 in the planning and design of an ERDA magnetohydrodynamics (MHD) component test facility at Butte, Montana, to:

- Provide, through the use of models, increased and more comprehensive consideration of environmental effects of combustion and the generation of trace elements or other toxic emissions.

OUTPUTS FROM THE FIRST INCREMENT (\$0)

Rank No. (None)

Same as minimum budget.

OUTPUTS FROM ADDITIONAL INCREMENT (\$200,000)

Rank No. 39

- The effects of fuel droplet size and distribution on gas turbine combustor emissions will be determined. This will contribute to the design of more efficient turbines with lower emissions. Included will be a determination of the effect of high fuel-bound nitrogen on NO_x emissions when using coal-derived liquid fuel. These outputs would lead to defensible emission standards for these processes.
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<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environmental	Control Technology	Energy Conservation & Adv. Energy Technology	Advanced Energy Systems

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-78 LOWEST LEVEL BUDGET</u>		<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA (IERL-Ci)	\$400,000	\$200,000	\$600,000
EPA (EMSL-LV)	100,000	100,000	100,000
TOTAL	\$500,000	TOTAL \$300,000	TOTAL \$700,000

STATEMENT OF PURPOSE

Assure that our environment will be properly protected from pollution resulting from the development and commercialization of geothermal and solar energy conversion technologies. Environmental assessments of these conversion technologies will be conducted to identify and characterize waste discharges, to predict their potential environmental effects, and to define required control technologies. These technologies will be developed and demonstrated where required and early enough to be applied by the time of full-scale commercialization. Realistic effluent and emission standards for these industries will be developed. In addition, because of the expected minimum environmental impact of solar energy systems, another purpose is to encourage the more rapid development and commercialization of this technology as a means of conserving conventional fuels.

USE OF OUTPUTS

- Geothermal fluid characterization and gaseous waste emission data and evaluation reports will be used by geothermal energy developers (both ERDA, DOI, and others) to begin to develop appropriate environmental protection procedures and devices.
- Reports will be used to establish, by EPA and/or State and local air and water pollution regulatory authorities, preliminary environmental standards, control guidelines and discharge permits for the geothermal industry.
- Reports will provide baseline information to help define for regulators, ERDA and the industry what new control techniques and processes need development.
- Evaluation reports of gas (principally H₂S) control technology will be used for air pollution control agencies, the industry and ERDA to show attainable emission levels; also input to EPA development of New Source Performance Standards.
- Solar energy outputs will be provided to industrial and residential sectors and ERDA to assist in fostering adoption of such technologies as pollution control alternatives.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$500,000)

Rank No. 9

- The pollutants and physical properties of geothermal fluids will be characterized for various locations.
- The characteristics of geothermal gaseous waste emissions from liquid-dominated resources and associated ranges of expected ecological effects will be determined.
- A preliminary evaluation will be made of noncondensable gas control technology that is applicable to the geothermal industry.
- Analysis will be made of the net environmental benefits from the replacement of fossil fuels by solar energy.
- An evaluation of the use of solar energy in wastewater treatment will be conducted.

OUTPUTS FROM FIRST INCREMENT (\$300,000)

Rank No. 24

- Ground water in geothermal areas will be characterized prior to development of geothermal resources providing a monitoring baseline for ground water protection to be used by agencies charged with protecting ground water quality.
- Chemistry of geothermal fluids upon loss of temperature and pressure and mixing with ground water will be investigated, and will provide data for use in the design of geothermal brine disposal wells. These data will be used by industrial developers and Federal/State ground water protection agencies.
- Solar energy use will be demonstrated at an EPA facility to conserve conventional fuels and to promote this technology to private and industrial sectors as an environmentally attractive pollution control alternative.

OUTPUTS FROM ADDITIONAL INCREMENT (\$700,000)

Rank No. 37

- Ecological changes and potential damage from mixing geothermal fluids with surface waters will be established; data will be used to develop adequate standards by EPA and the States for protection of surface waters.
 - First phase efforts toward development of wastewater control technology will coincide with conversion technology application; to be used by EPA to develop effluent and emission standards, and by plant designers.
 - Environmental assessment of ocean thermal energy conversion power generation plants will be conducted; output will help to assure that adequate environmental controls are developed; to be used by EPA, DOI, ERDA, States and industrial developers; guidelines would eventually result.
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<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Energy Conservation & Advanced Energy Technology	Industrial Energy Conservation

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>		<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA	\$400,000	\$300,000	\$500,000
TOTAL	\$400,000	TOTAL \$300,000	TOTAL \$500,000

STATEMENT OF PURPOSE

This program will assess the probable environmental benefits and consequences of enforced and/or voluntary energy conservation in the United States. Particular attention will be given to industrial energy conservation. The assessments will describe waste discharges, environmental effects, and required controls resulting from energy conservation techniques likely to be adopted within 5-10 years. The program will emphasize environmental benefits of energy conservation through decreased and/or optimal usage of fuels and the recovery and utilization of currently-wasted heat. In addition, the program will identify techniques that are more energy efficient and environmentally beneficial. The program will assist in demonstrating such techniques and encouraging their applications.

USE OF OUTPUTS

- Reports from a study of the environmental benefits of energy conservation for selected Air Quality Control Regions will be used by EPA, State air quality planners, permit authorities, and energy conservation planners to determine whether environmental quality could be improved or whether pollution increments resulting from industrial growth might be partially or totally compensated for by the adoption of area-wide energy conservation methods.
- The reports from an assessment of waste heat utilization will be used in assisting Federal, State and local energy and environmental agencies and industrial planners in developing methods and technologies for recovery and use of waste heat resulting in environmental and energy payoffs.
- The information developed from a demonstration of hyperfiltration will be used by regulatory offices in the development and/or revision of Effluent Guidelines to reduce pollution loadings in the textile dyeing and finishing industry. The reports will be used by design engineers for the development of water pollution control systems.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$400,000)

Rank No. 15

- Identification and quantification of the impact of various degrees and types of energy conservation activities on pollution discharges in typical Air Quality Control Regions, including some in which ambient air quality standards are being violated.
- Description and assessment of waste heat utilization potential in the industrial sector and the environmental benefits of recovering and using such heat.

- Demonstration of hyperfiltration as a pollution control process for the textile dyeing and finishing industry with the ability to meet 1983 Effluent Guidelines which simultaneously conserve energy.

OUTPUTS FROM THE FIRST INCREMENT (\$300,000)

Rank No. 28

- Detailed energy requirements for municipal and industrial pollution control processes. Results would be used by design engineers in specifying the most energy-effective and environmentally adequate methods.
- Assessment of the feasibility of recovering waste industrial hydrocarbons as an energy source and simultaneous pollution control method; this alternative can then be considered by design engineers and regulatory authorities.

OUTPUT FROM ADDITIONAL INCREMENT (\$500,000)

Rank No. 41

- Determination of trade-off between energy extraction from hot stack gases and the adverse environmental effects of reduced plume temperatures; output would be used by both regulatory authorities and design engineers.
 - Assessment of the potential for environmental benefits from industrial process use of energy conserving fluidized bed combustion; this output would be used by process development engineers and regulatory officials.
 - Analysis of pollutant type and emission levels from new energy-efficient primary copper smelting processes; output would be used by EPA in developing New Source Performance Standards.
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<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Energy Conservation & Adv. Energy Technology	Wastes as Fuel

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>	<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA (pass-thru to Navy) \$ 300,000	\$ 200,000	\$ 0
EPA (MERL) --	325,000	75,000
EPA (IERL-Ci) 2,600,000	675,000	825,000
TOTAL \$2,900,000	TOTAL \$1,200,000	TOTAL \$900,000

STATEMENT OF PURPOSE

The principal objective of the EPA waste-as-fuel research program is to assure that solid waste will be used effectively to help meet our energy needs in an environmentally acceptable fashion. Recent environmental regulations are forcing some communities to consider alternatives to land and ocean dumping of solid wastes. Use of wastes as fuel minimizes the problems of disposing of solid wastes while permitting recovery of energy and other material values. Use of wastes as fuels presents an unusual set of environmental impacts arising from the diversity of materials being processed. These problems will be addressed through developing systems which provide cost-effective municipal/industrial/agricultural solid waste management and simultaneous beneficial energy recovery with proper control of undesirable air, water, and land pollution impacts.

USE OF OUTPUTS

- Federal (EPA), State and local environmental bodies having regulatory (standards-setting and enforcement) responsibilities will use results to establish practicable and environmentally acceptable standards and guidelines for the developing waste-as-fuel industry.
- Municipalities, industries, and utilities and their consulting engineers and equipment vendors will apply the results of this research in determining whether and when to proceed with full-scale, broad applications of these technologies.
- Federal and State energy agencies (e.g., ERDA) will utilize program outputs:
 - to help in establishing their own positions and priorities with regard to waste-as-fuel technologies; and
 - to encourage the transition from demonstration programs to full-scale commercialization.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$2,900,000)

Rank No. 7

The program will produce technological, economic, and environmental assessments of several of the major waste-as-fuel processes under development. The R&D will include the development and the environmental assessment, on a large scale, of at least five different waste-as-supplementary fuel options (using industrial, municipal, and agricultural wastes as the supplementary fuels). The research will also produce bench-scale and pilot-plant scale data to enable generation of various parametric technical and environmental analyses applicable to concurrently developing waste pyrolysis processes.

A summary of the major outputs from the Lowest Level Program is:

- Feasibility studies for two new waste-as-fuel processes will be completed (e.g., bench-scale R&D on an improved waste liquefaction process).
- Assessments of co-firing municipal solid waste, sewage sludge and several industrial wastes with coal will be carried out; these technological assessments will determine the environmental implications of these processes as well.
- EPA's waste-to-gasoline project with the Navy will be developed through the pilot-plant scale.
- EPA's portable pyrolysis project for agricultural waste will be completed; energy products include readily transportable fuel oil and char.
- Three additional commercial-scale waste-as-fuel technologies will be thoroughly assessed via detailed environmental pollution characterizations (e.g., a municipal waste co-firing with coal option or a hazardous industrial waste pyrolysis option); third-party process evaluations (technical and economic) of waste-as-fuel technologies will be completed.
- Several air and water pollution control devices will be developed and evaluated at pilot-plant scale for their efficiencies in removing air and water pollutants from waste-as-fuel processes; "air" devices will include, for example, high-energy scrubbers for the capture of HCl and incremental Hg and Pb emissions coming from waste co-firing with coal operations.

OUTPUTS FROM THE FIRST INCREMENT (\$1,200,000)

Rank No. 22

Funding of this increment will provide the following outputs in addition to the outputs described for the lowest level program:

- A feasibility study of the multi-waste gasification/pyrolysis process will be completed... a very promising alternative to waste co-combustion at existing power plants will thus be evaluated for the benefit of the utility and petroleum refining industries.
- Bioconversion of waste materials to fuel (e.g., acid hydrolysis) will be evaluated to assess its probable technical, economic and environmental feasibility; this will provide the industrial chemicals and petrochemicals industries with information on potential waste-derived feedstocks and fuel-extenders.
- Evaluations of several innovative techniques for preparation of waste-as-fuel materials for conversion to energy (e.g., new shredding and classification methods) will be produced; the entire waste-to-energy technological area will benefit from this research.
- A fourth commercial-scale waste-as-fuel technology will be assessed providing the data for New Source Performance Standards.

OUTPUT FROM ADDITIONAL INCREMENT (\$900,000)

Rank No. 35

Funding to this level will provide the following outputs in addition to those previously mentioned:

- Pilot-plant scale testing of the multi-waste gasification concept will be conducted; the concept involves the clean, centralized gasification/pyrolysis of many different wastes (e.g., municipal refuse, sewage sludge, hazardous industrial wastes/sludges, agricultural wastes, etc.) into three much-needed energy products--fuel gas, fuel oil and char. Pilot development of this promising technology will benefit municipalities, industrial and agricultural operations having waste disposal problems, and the power and petroleum refining industries, as well as improve the outlook for solving our energy/environmental problem.
- The initial phase of a major effort on agricultural waste conversion to energy will be completed, thereby benefiting those States with agricultural waste disposal problems and dwindling energy supplies.

HEALTH AND ECOLOGICAL EFFECTS

ZBB Decision Activities-Health and Environmental Effects (Energy)

	75%		100%		125%	
	\$,K	RANK	\$,K	RANK	\$,K	RANK
<u>Ecological Effects (625A)</u>						
Aquatic Effects	2102	7	1000	23	1000	49
Marine Effects	4336	8	1000	24	1000	48
Terrestrial Effects	1332	16	1000	27	-	
Reclamation/Revegetation	677	17	500	28		
<u>Environmental Transport Processes (625B)</u>						
Atmospheric Transport & Transformation	1650	6	1000	37	550	54
Weather Modification	-	22	135	33		
Aquatic Transport	342	14	630	25		
Marine Transport	752	15	400	26		
Groundwater Transport	115	18	300	29	500	52
<u>Monitoring (625C)</u>						
Air Monitoring	1555	3			1000	42
Water Monitoring	779	4	280	40	800	43
Groundwater Monitoring	300	21	410	32	500	53
Land Use Monitoring	450	19	455	30		
Quality Assurance	1436	5	300	41		
<u>Instrumentation (625D)</u>						
Air Instrumentation	1051	12	300	38	700	50
Water Instrumentation	952	13	300	39	500	51
Remote Instrumentation	191	20	290	31		
<u>Health Effects (625F)</u>						
Hazardous Agent I.D.	1079	1			250	55
Dose and Damage Indicators	1888	10	500	34	500	47
Metabolism of Hazardous Agents	1187	9	500	35	750	46
Evaluation of Hazards to Man	6031	2			750	44
Damage/Repair/Recovery Processes	1195	11	500	36	1000	45
	29400		9800		9800	

ZBB DECISION ACTIVITY PRIORITY RANKING
HEALTH AND ENVIRONMENTAL EFFECTS (ENERGY)

<u>LOWER BUDGET</u>		<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
	(\$x1,000)	(\$x1,000)	(\$x1,000)
1. Hazardous Agent I.D.	1079	23. Aquatic Effects	42. Air Monitoring
2. Evaluation of Hazards to Man	6031	24. Marine Effects	43. Water Monitoring
3. Air Monitoring	1555	25. Aquatic Transport	44. Evaluation of Hazards to Man
4. Water Monitoring	779	26. Marine Transport	45. Damage/Repair/Recovery
5. Quality Assurance	1436	27. Terrestrial Effects	46. Metabolism of Hazardous Agents
6. Atmospheric Transport	1650	28. Reclamation Revegetation	47. Dose & Damage Indicators
7. Aquatic Effects	2102	29. Groundwater Transport	48. Marine Effects
8. Marine Effects	4336	30. Land Use Monitoring	49. Aquatic Effects
9. Metabolism of Hazardous Agents	1187	31. Remote Instrumentation	50. Air Instrumentation
10. Dose & Damage Indicators	1888	32. Groundwater Monitoring	51. Water Instrumentation
11. Damage/Repair/Recovery	1195	33. Weather Modification	52. Groundwater Transport
12. Air Instrumentation	1051	34. Dose & Damage Indicators	53. Groundwater Monitoring
13. Water Instrumentation	952	35. Metabolism of Hazardous Agents	54. Atmospheric Transport
14. Aquatic Transport	342	36. Damage/Repair/Recovery	55. Hazardous Agent I.D.
15. Marine Transport	752	37. Atmospheric Transport	
16. Terrestrial Effects	1332	38. Air Instrumentation	
17. Reclamation/Revegetation	677	39. Water Instrumentation	
18. Groundwater Transport	115	40. Water Monitoring	
19. Land Use Monitoring	450	41. Quality Assurance	
20. Remote Instrumentation	191		
21. Groundwater Monitoring	300		
22. Weather Modification	-		
Total	29,400	9800	9800

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Ecological Effects	Aquatic Effects

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1976 Minimum Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>	
EPA	1,450,000	EPA	180,000	EPA	500,000
ERDA	100,000	ERDA	200,000	ERDA	
FWS	550,000	FWS		FWS	500,000
TVA		TVA	350,000	TVA	
USDA		USDA	270,000	USDA	
TOTAL		1,000,000		1,000,000	

STATEMENT OF PURPOSE

Aquatic organisms and ecosystems may be impacted by energy development activities associated with nearly every phase of most fuel cycles. The purpose of this activity is to determine the effects on aquatic organisms and resultant ecosystem impacts at each stage of the energy fuel cycles (primarily coal and oil shale).

USE OF OUTPUTS

This activity is designed to provide the ecological information required in making management and policy decisions concerning coal, oil, oil shale, and geothermal development and facility siting decisions. The nature and extent of organism and ecosystem responses to specific pollutants and combinations of pollutants form the basis for establishing effluent discharge limitations, requirements for control technology performance, as well as provide necessary information for regulatory and enforcement actions. The consequences of discontinuing this activity would be to preclude the timely availability of adequate and accurate environmental impact information for consideration in coal, oil shale and geothermal energy development policy and decision-making. There would be a high probability of long-term contaminations of aquatic resources, loss of fish and wildlife habitat, recreational resources and resultant economic impacts. Excessive costs for retrofitting facilities and environmental clean-up could be expected.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$2,100,000)

Rank No.

7

Specific outputs of this activity will include determination of the acute and chronic toxicity of chemicals from coal and oil shale leachate, and residues from conversion on freshwater organisms and ecosystems; impacts on freshwater organisms and ecosystems from oil spills in arctic and subarctic environments; determination of water quality needs and in-stream flow requirements for fish and wildlife in the Upper Missouri and Upper Colorado River Basins; and the development of biological indices of pollution effects on aquatic ecosystems. Specific projects making up the minimum budget program have been underway for three years and are scheduled to be completed with FY-78 funds.

OUTPUTS FROM FIRST INCREMENT (\$1,000,000)

Rank No.

23

- Development of techniques for predicting thermal impacts on freshwater fish, shellfish and other organisms.
- Development of management practices for restoring the surface and subsurface hydrology of strip-mined areas.
- Evaluation of oil spill effects on tundra and thaw ponds.
- Assessment of pipeline construction effects on arctic aquatic habitats.

Specific projects leading to these outputs have been underway for three years and are scheduled for completion with FY-79 funds.

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,000,000)

Rank No.

49

- Assessment of resiliency or capacity for recovery of aquatic ecosystems after cessation of pollutant input or ecological stress.
- Development of methodologies for predicting long-term shifts in aquatic ecosystem structure, function, and diversity from continuing acute and chronic organism stress.

These outputs represent relatively new areas of research and, if successful, would provide an understanding of the permanency or transiency of ecosystem changes caused by episodic stress and the ability of ecosystems to recover when stress has ceased. Projects of this type would require funding for three to five years.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Ecological Effects	Marine Effects

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Minimum Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>	
EPA	1,326,000	EPA	385,000	EPA	250,000
FWS	890,000	FWS	200,000	FWS	500,000
NOAA	1,870,000	NOAA		NOAA	250,000
NIEHS		NIEHS	180,000	NIEHS	
ERDA	250,000	ERDA	235,000	ERDA	
TOTAL	4,336,000		1,000,000		1,000,000

STATEMENT OF PURPOSE

The marine, estuarine, and coastal environments will be impacted by accelerated domestic energy development activities associated with offshore oil and gas exploration and production; deepwater ports; and expansion of associated coastal support activities, refining capacity and coastal or offshore power plants. The purpose of this activity is to determine the effects on marine, estuarine, and coastal organisms and ecosystems of each stage (exploration, extraction, processing, conversion, and utilization) of the energy source fuel cycles (primarily petroleum).

USE OF OUTPUTS

This activity is designed to provide the ecological information required in making management and policy decisions concerning offshore oil and gas development; the siting of coastal support facilities, refineries, power generating facilities, and deepwater ports. The nature and extent of organism and ecosystem responses to specific pollutants and combinations of pollutants form the basis for establishing effluent discharge limitations, requirements for control technology performance, as well as provide necessary information for regulatory and enforcement actions. For example, the current use of chlorine and the use of other proposed oxidants as biocides in power plant cooling facilities and their possible adverse effects on marine and estuarine ecosystems is highly significant to future decisions on expansion of power generation facilities in coastal habitats.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$4,336,000)

Rank No.

8

Specific outputs from this activity will include: marine, estuarine and coastal environmental baselines including biological, physical, chemical, and geological components and background concentrations of energy-related pollutants for specific areas expected to be heavily impacted by energy development activities; identification of acute and chronic toxicological responses of marine, estuarine, and coastal organisms and ecosystems to petroleum hydrocarbons and their derivatives, as well as biocides and antifouling chemicals used in drilling operations and cooling facilities; immediate and long-term non-pollutant effects of energy development activities including physical and biological changes in marine, estuarine and coastal ecosystems; and development and testing of predictive models for evaluating pollutant and non-pollutant effects on marine, estuarine, and coastal organisms and ecosystems. Specific projects making up the minimum level program have been underway for three years and are scheduled for completion with FY-78 or FY-79 funds.

OUTPUTS FROM FIRST INCREMENT (\$1,000,000)

Rank No.

24

- Determination of the effects of petroleum and other energy-related stresses on the rates and mechanics of nutrient regeneration by coastal marine bottom communities.
 - Determination of the effects of oil on reproduction and other physiological functions of sea birds.
 - Determination of mechanisms of cellular uptake of metals and petroleum hydrocarbons by marine organisms.
 - Completion of ecological baseline for Santa Barbara oil lease area.
- Specific projects leading to these outputs have been underway for three years and are scheduled for completion with FY-78 funds.

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,000,000)

Rank No.

48

- Assessment of resiliency or capacity for recovery of marine, estuarine, and coastal ecosystems after removal of pollutant input or ecological stress.
 - Development of methodologies for predicting long-term shifts in marine, estuarine, and coastal ecosystem structure, function and diversity from continuing acute or chronic organism stress.
- These outputs represent relatively new areas of research and, if successful, would provide an understanding of the permanency or transiency of ecosystem changes caused by episodic stress and the ability of ecosystems to recover when stress has ceased. Projects of this type would require funding for three to five years.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Ecological Effects	Terrestrial Effects

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Minimum Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>
EPA	707,000	EPA	583,000	
FWS	350,000	FWS	350,000	
TVA	400,000	TVA	65,000	
TOTAL		1,000,000		

STATEMENT OF PURPOSE

Increased reliance on domestic energy sources is resulting in increased mining and combustion of coal. The purpose of this activity is to determine what effects the combustion of coal in large power plants will have on the surrounding terrestrial organisms and ecosystems primarily via SO₂, NO_x, CO, particulate, and oxidant emissions, and to determine ecosystem requirements of economically important wildlife species.

USE OF OUTPUTS

The ability to predict immediate and long-term impacts of coal combustion on the surrounding vegetation is required by regulatory and planning groups in making facility siting decisions and in specifying requirements for emissions control technology and air quality standards. The consequences of discontinuing this action would be to sacrifice four years of power plant "pre-operational" ambient air quality data which forms the baseline for comparison of air quality after power plant operations begin. Subtle changes in ecosystem structure, diversity and productivity are likely to go undetected until the general deterioration of the ecosystem is far advanced resulting in loss of wildlife habitat or use for grazing or other agricultural purposes.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$1,322,000)

Rank No.

16

Information developed under this activity will include comparison of ambient pollutant levels (before power plant operation begins) with levels after a plant reaches full operation; immediate and long-term dose/response relationships for crop species and native vegetation exposed to single pollutants and combinations of pollutants released by coal combustion. Metabolic and biochemical mechanisms and lethal and chronic toxicity levels will be determined under structured field and laboratory conditions. Biological indices of pollutant damage will be developed. Predictive models will be developed for determining the impact of coal combustion on commercial and non-commercial species. Specific projects being conducted under the minimum budget program have been underway for four years in the Northern Great Plains and for three years in the Southeastern and Southwestern U.S. These projects are scheduled for completion with FY-79 funds.

OUTPUTS FROM FIRST INCREMENT (\$1,000,000)

Rank No.

27

- Determine the effects of moisture, heat, and chemical releases from mechanical draft cooling towers on surrounding vegetation and soils.
- Determine how various coal development related activities, particularly processing and population growth, will effect wildlife.
- Determine lethal and chronic toxicity levels for terrestrial organisms under actual field conditions.

These projects will be completed with FY-78 funds.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Ecological Effects	Reclamation/Revegetation

RESOURCE DISTRIBUTION BY AGENCY

FY-1978 Minimum Budget		First Increment		Additional Increment
USDA	677,000	USDA	630,000	
TVA		TVA	70,000	
TOTAL		700,000		

STATEMENT OF PURPOSE

Much of the coal and oil shale resources in the western states is subject to surface or strip mining. Reclamation and revegetation in the arid west poses problems not before encountered on a large scale. The purpose of this activity is to develop field and laboratory procedures to characterize the physical and chemical properties of overburden materials and the effects of time on weathering, leaching and other changes in mine spoils, and to provide guidelines for soil amendments, plant species, and management practices best suited to reclaiming and utilizing strip-mined areas under arid conditions.

USE OF OUTPUTS

Information developed by this activity will be used by Federal, state and local conservation, reclamation and environmental control agencies, as well as the mining industry. The findings will influence the location of mining sites and will result in guidelines and methodology for rehabilitation of surface mined areas. The ability to successfully rehabilitate surface mined areas will permit the fullest possible use of western coal and oil shale resources without sacrificing the long-term economic, recreational or aesthetic value of the land. The consequences of not continuing this activity would be to preclude adequate restoration of surface mined lands in the west; loss of wildlife habitat; water quality degradation extending far beyond the disturbed surface areas and severely limit the future utility of mined-out areas.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$677,000)

Rank No.

7

The outputs of this activity include the development and validation of models for predicting the effects of strip-mining and reclamation practices on the quantity and quality of water leaving the area; determination of the nutritional value of forages and other crops grown on reclaimed areas; development of techniques for redepositing and stabilizing mine spoils in a manner that will enhance both plant growth and water quality for associated aquatic life; and identification of plant species and successions best suited for revegetating mine spoils and strip-mined lands under water-short conditions. Because these projects deal with plant growth characteristics and spoil stabilization techniques, they are inherently long-term in nature. These projects have been underway for three years and are scheduled to continue through FY-79.

OUTPUTS FROM FIRST INCREMENT (\$700,000)

Rank No.

28

- Determination of the rates of ecological recovery after initiation of reclamation of toxic spoil left by surface coal mining.
 - Development of methodologies for utilizing strip-mined lands for production of speciality crops.
 - Assess and model effects of previous mining methods, spoil characteristics and reclamation on surface and sub-surface hydrology including water quality.
 - Expand existing "Resource Inventory, Information Management and Monitoring System" for collection, assimilation and analysis of natural resource and pollution data related to coal extraction.
- Because these projects deal with plant growth characteristics and spoil stabilization techniques, they are inherently long-term in nature. These projects have been underway for three years and are scheduled to continue through FY-79.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes & Effects Research	Transport & Fate	Atmospheric Transport and Transformation

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>	
EPA	1,400,000	EPA	1,000,000	EPA	550,000
TVA	250,000				
TOTAL	1,650,000		1,000,000		550,000

STATEMENT OF PURPOSE

Pollutants released to the atmosphere through fossil fuel combustion and their secondary products produced in the atmosphere have been shown to have a direct impact on human health, commercial and non-commercial crops, undesirable effects on aesthetics and climate, and are suspected of effecting the radiation balance of the earth. The purpose of this activity is to determine the atmospheric and meteorological conditions, chemical and physical mechanisms, and transformation rates by which primary pollutants such as sulfur and nitrogen oxides associated with coal, oil, and shale oil conversion and utilization are converted in the atmosphere to secondary pollutants such as sulfates and nitrates; and to develop and evaluate mathematical models for determining and predicting the generation, transformation, transport and removal of secondary pollutants and their precursors in plumes from coal, oil, and shale oil conversion, and utilization in areas of both simple and complex terrain.

USE OF OUTPUTS

The models will be used to establish a quantitative, cause and effect relationship between the distribution of secondary pollutants in a given area and the production of primary emissions by a source or set of sources in a nearby or distant area. Because atmospheric pollution is a regional as well as local phenomenon, such models are pre-requisite to the development of a rational air pollution control strategy.

In the case of new facilities, such models are needed to determine the impact of the choice of a particular site on areas hundreds of kilometers distant. Thus the pattern of new energy development can be adjusted to minimize atmospheric impacts. In the case of the second generation fossil fuel technologies, early identification of hazardous secondary pollutants can be used to impact the design and control technology required for a given process or even to assist in the choice between different technologies.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,650,000)**Rank No.****6**

A predictive model will be developed for assessing the atmospheric transformation, transport and dilution of sulfur and nitrogen compounds from coal and oil-fired power plants based on extensive field studies.

An assessment will be made of the atmospheric transport and dilution of pollutants from a large, single source in complex terrain for distances in the 0-100km and greater ranges. This will be applicable to mine-mouth power plants, shale oil conversion, and coal gasification plants in various locales characteristic of the Eastern U.S.

An assessment will be made of the atmospheric chemistry of pollutants from petroleum complexes and their effects on oxidant transport.

An assessment will be made of the atmospheric chemistry of emissions, both inorganic and organic, from second generation fossil fuel technologies.

Predictive models will be applied to transformation and transport of emissions and secondary pollutants from second generation fossil fuel conversion and utilization facilities (coal gasification, liquefaction, etc.)

OUTPUTS FROM FIRST INCREMENT (\$1,000,000)**Rank No.****37**

Identification of organic compounds formed in the atmosphere which are derived from primary emissions from advanced fossil fuel combustion and conversion processes (coal gasification, oil shale processing, etc.).

Systematic field studies at approximately six advanced fossil fuel combustion and synthetic fuels pilot and demonstration plants will determine the precursor chemical constituents and range of physical and meteorological conditions which lead to the formation of hazardous organics in the atmosphere due to these technologies. This is to provide a basis for the control of such pollutants in commercial sized plants and to identify compounds and concentrations for which additional health related exposure studies need to be done.

Baseline studies on current levels of hazardous organics in areas where new combustion and synthetic fuels plants are planned. This is necessary now to document the actual contribution of planned facilities to atmospheric levels of such hazardous organics and is essential to future control decisions and potential standards development. At present, no adequate data baseline exists for the types of organics which constitute emissions from such energy technologies. Candidate study areas are in Ohio River Basin.

OUTPUTS FROM ADDITIONAL INCREMENT (\$550,000)**Rank No.****54**

Development of a comprehensive complex terrain model which can be used for the accurate modeling of air pollution distribution and transport due to power plant and fuel conversion plant emissions in areas with the geographical and meteorological character of the mountainous areas of Western U.S. This model will contain adjustments for seasonal weather variations. It will be used in deriving the air quality implications of various new plant siting options and in determining the contribution to and extent of impact on regional air quality for emissions from fossil fuel plants.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Transport Processes	Weather Modification

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Minimum Budget</u>	<u>First Increment</u>		<u>Additional Increment</u>
Zero	EPA	45,000	
	ERDA	90,000	
TOTAL	135,000		

STATEMENT OF PURPOSE

Evaporative cooling towers are used as an alternative to once-through cooling to eliminate thermal pollution of water. However, side effects from cooling towers could result in adverse weather effects such as atmospheric fogging, local road icing, and ground level deposition of salt nuclei. The purpose of this activity is to determine the precursor conditions for such effects and develop the ability to predict the nature and extent of weather modification effects under various climatic and geographic conditions.

USE OF OUTPUTS

The models will be used by regional and local planning and regulatory groups in power plant siting as well as in policy decisions concerning regional power parks. Discontinuing this activity would preclude the ability to give proper consideration of weather modification effects in power plant siting decisions and possibly result in nuisance conditions in the areas adjacent to power plants.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$Zero)

Rank No.

22

Under the constraints of a minimum budget, this activity would not be funded.

OUTPUTS FROM FIRST INCREMENT (\$135,000)

Rank No.

33

- A working model and workbook for predicting weather modification effects from cooling tower plumes and the interaction of cooling tower and power plant plumes. The output will include an assessment of longer range regional effects which might occur from source intensification such as power parks.

This work will be completed with FY-78 funds.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Transport Processes	Aquatic Transport

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1973 Minimum Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>
EPA	272,000	EPA	430,000	
ERDA	70,000	ERDA		
TVA		TVA	200,000	
TOTAL		630,000		

STATEMENT OF PURPOSE

As pollutants move through the environment, their physical, chemical, and biological interactions often result in their transformation to new compounds which may be either a greater or lesser environmental threat than the parent compound. The purpose of this activity is to determine the origins, loads, transport pathways, transfer rates, and fates for single pollutants and combinations of pollutants released to the aquatic environment primarily from the coal, oil shale, and geothermal fuel cycles.

USE OF OUTPUTS

Knowledge of the environmental transport and transformation of pollutants is essential to relating ecological effects to their cause, and for establishing monitoring and surveillance programs. This information is also basic to setting standards for point source control, and for development of treatment methods and evaluation of their effectiveness. Since compounds often do not remain static in the environment, discontinuance of this activity would impair the ability to understand many organism and ecosystem effects, and to relate effects to proper causes.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$342,000)

Rank No.

14

Outputs from this activity include development of simple aquatic system models to predict the distribution and probable transport or degradative pathways and life-times for specific pollutants common to several energy fuel cycles, as well as pollutants specific to western coals. Emphasis is on potentially carcinogenic compounds.

The transport, transformations, and fates of three to five specific pollutants are determined annually at this minimum funding level. Work has been underway for three years and these specific projects are scheduled for completion with FY-78 funds.

OUTPUTS FROM FIRST INCREMENT (\$972,000)

Rank No.

25

- Determine formation rates of inorganics with acid formed from strip mines.
 - Develop mathematical models to predict water quality in streams in acid mine areas.
 - Determine transport, degradation products, and fate in aquatic ecosystems of pollutants specific to oil shale development.
- These projects are scheduled to be completed with FY-78 funds.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Transport Processes	Marine Transport

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Minimum Budget</u>		<u>First Increment</u>	<u>Additional Increment</u>
EPA	382,000		
NOAA	310,000	NOAA 100,000	
TOTAL		100,000	

STATEMENT OF PURPOSE

As pollutants move through the environment, their physical, chemical, and biological interactions often result in their transformation to new compounds which may be either a greater or lesser environmental threat than the original pollutant. The purpose of this activity is to determine the origins, loads, transport pathways, transfer rates, and fates for single pollutants and combinations of pollutants released to the marine, estuarine, and coastal environments primarily from offshore oil and gas development and associated coastal activities.

USE OF OUTPUTS

Knowledge of the environmental transport and transformation of pollutants is essential for relating ecological effects to their cause, and for establishing monitoring and surveillance programs. This information is also basic for standards setting for point source control. Since compounds often do not remain static in the environment, discontinuance of this activity would impair the ability to understand many organism and ecosystem effects, and to relate effects to proper causes.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$752,000)

Rank No.

15

Outputs from this activity include development of ecosystem models of the transport of petroleum hydrocarbons, organic and inorganic pollutants, and metals in arctic, subarctic, and mid-latitude marine and estuarine environments; determination of the correlation between results of laboratory bioassay of system components and field study of bioaccumulation, system dynamics, and routes to man for pollutants released from offshore drilling, coastal refinery effluents, biocides and anti-fouling chemicals, and direct oil spills.

While these specific projects will be completed with FY-78 and FY-79 funds, it is planned to verify laboratory results under experimental ecosystem or actual field conditions during FY-79 and FY-80.

OUTPUTS FROM FIRST INCREMENT (\$100,000)

Rank No.

26

- Extend capability for routine analyses of petroleum hydrocarbons in the marine environment.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects	Transport Processes	Groundwater Transport

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Minimum Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>	
EPA	115,000	EPA	400,000	EPA	500,000
TOTAL	115,000		400,000		500,000

STATEMENT OF PURPOSE

Groundwater resources can be contaminated by energy development activities that disrupt aquifers bringing pollutants into direct contact with the groundwater systems; through percolation of pollutants from surface sources; and through interconnection with polluted surface water sources. The purpose of this activity is to assess the nature and amount of contaminants entering the groundwater system from energy-related activities and to evaluate existing models for predicting the spatial and temporal transport and transformation of these contaminants in the subsurface.

USE OF OUTPUTS

Groundwater pollution can be directly measured only at relatively few locations (wells, springs, etc.), groundwater flow and pollutant transport models are therefore the basic tool for determining the movement and dilution of pollutants in the subsurface. Numerous groundwater models exist. A state-of-the-art assessment of existing capabilities will preclude future duplication of efforts, indicate where additional work is needed, and provide an essential tool for assessing potential groundwater problems associated with energy production. Establishment of the relationship between overburden and spoil mineralogy and groundwater pollution potential is necessary for proper reclamation practices. Over 90% of the rural domestic water supply in the United States is from groundwater. For all practical purposes, once contaminated aquifers cannot be restored to their original condition, natural flushing action may require centuries and pumping techniques have proved inadequate. Prevention of contamination, therefore, is the only viable method of groundwater quality protection.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$115,000)

Rank No.

18

The output of this activity under minimum budget conditions would be limited to completion of an evaluation of the relationship between overburden and spoil mineralogy in western surface-mined areas and the potential for groundwater contamination.

This project has been underway for two years and will be completed in FY-78.

OUTPUTS FROM FIRST INCREMENT (\$400,000)

Rank No.

29

- Assessment of the potential for groundwater contamination from in-situ oil shale retorting.
Little, if any, actual field work has been done in this area. A three year project is planned with possible extension or early termination depending upon the success of pilot or experimental in-situ retorting efforts.

OUTPUTS FROM ADDITIONAL INCREMENT (\$500,000)

Rank No.

52

- Assessment of the impacts on groundwater resources from strip-mining of coal aquifers.
Because groundwater movement is extremely slow (feet per day to feet per year), a three to five year project is planned. Outyear resources, however, would be reduced to \$100,000 to \$150,000 per year once the initial monitoring wells were installed.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes & Effects Research	Measurement & Monitoring	Air Monitoring

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>	<u>First Increment</u>	<u>Additional Increment</u>
EPA 1,075,000 NOAA 480,000	EPA 0 NOAA 0	EPA 800,000 NOAA 200,000
TOTAL 1,555,000	0	1,000,000

STATEMENT OF PURPOSE

The Northern Great Plains and Rocky Mountain Provinces are projected within 10 years to triple the regional power output from conventional power plants and to see large scale demonstrations of coal and oil shale conversion, with commercial industrialization to follow. Air pollution from these sources will alter air quality on a regional as well as local basis. The excellent air quality in this region as a whole has made non-significant deterioration of air quality an ongoing issue. Also, the classification of air quality areas in this region will have a significant impact on the existence and growth of such energy industries in the region. However, an accurate regional air quality baseline does not exist. Because an accurate knowledge of present air quality is needed throughout this region for such policy judgments, this activity's purpose is to establish such a baseline overview with special attention to the projected pattern of development and to the meteorological influences which will determine the areas of impact of new energy-related air pollution sources throughout the region.

USE OF OUTPUTS

The activity is designed to provide an accurate, consistent framework for regional air quality information as it relates to the pattern of energy growth in that region. This information is the bench mark for future decisions on non-significant deterioration and on the limitation of area energy development in order to maintain a certain level of air quality. This information provides a reference for future regulatory, regional development, and siting decisions, especially in cases where the source is shown to impact areas within a different jurisdiction.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,555,000)Rank No.

3

Specific outputs of this activity will include the establishment of an accurate and consistent long term air quality baseline for criteria and certain elemental pollutants associated with the various energy technologies which exist or are to be developed in this region; an overview of the areas of impact throughout the region associated with both existing and projected sources (this using existing air quality and meteorological models); an assessment of where air quality information critical to policy and siting decisions is lacking; an indication of where adverse impacts on critical areas such as cities and national parks may be expected from air pollution due to specific new sources; indication of the characteristics of long range transport of potential pollution specific to the terrain and seasonally adjusted meteorology of this region; initiation of fine particulate and sulfate measurements in this region, involving sampling for sulfate at over 70 sites in 10 western states where no sulfate data has been taken. All such sites are located in proximity to power plants or to areas planned for fossil fuel combustion or conversion facilities. Periodic wide area monitoring and long range plume sampling by aircraft is an integral part of this effort.

OUTPUTS FROM FIRST INCREMENTRank No.

No first increment.

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,000,000)Rank No.

42

Baseline monitoring and meteorological modeling study is aimed at providing valid ambient baseline and initial trends data in air quality and at determining character of regional transport phenomena for critical pollutants, sulfate and fine particulate aerosol for regions of the Southeast and Midwestern U.S. where major additions in fossil fuel power plants capacity is planned, this to make possible the establishment of a relationship between regional air quality degradation and the construction of new fossil fuel plants, with a view toward altering siting plans and documenting viable regional sulfate control options. This is needed as a reference point from which to judge allowable air quality degradation and the associated limit on regional fossil fuel emissions. This will entail the initiation of sulfate and fine particulate sampling at up to 50 sites along trajectories where assessment studies have shown existing and especially planned fossil fuel facilities will tend to increase population exposures. These areas have been identified as having inadequate or no sulfate data base. Candidate areas involve sites in the Alabama, Georgia, Tennessee region and in the Texas, Oklahoma region.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes & Effects Research	Measurement and Monitoring	Water Monitoring

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>		<u>First Increment</u>	<u>Additional Increment</u>
EPA	250,000	USGS 280,000	EPA 200,000
USGS	329,000		USGS 600,000
NOAA	200,000		
TOTAL	779,000	280,000	800,000

STATEMENT OF PURPOSE

A number of key river basins in the Western and Eastern U.S. are projected within 10 years to be subject to major increase in strip mining, in some cases associated with power plants or gasification plants. The Upper Colorado Basin harbors a potential wealth of oil generated from shale. Additional power plants associated with intensified coal production are also planned in both East and West. Developments will have significant impacts on water quality through contamination and displacement of stream flow. An adequate data base for water quality does not exist in these areas. The purpose of this activity is to supplement the regional water quality network in these energy intensive areas in order that actual rates of water quality degradation associated with such developments can be ascertained. Based on this, decisions can be made on acceptable levels of development.

In addition, on both coasts it is necessary to predict and track the path of oil pollution from Outer Continental Shelf Development before marine pollution monitoring can be deployed. Activity in model design is aimed at satisfying this need.

USE OF OUTPUTS

This activity is designed to provide an accurate, consistent framework for regional water quality information as it relates to the pattern of energy development in that region. This information will provide a reference against which future water quality degradation can be measured and an accurate assessment of the allowable margin for the region can be judged. This information will provide the basis for regional water quality planning as well as for regulatory actions affecting the above-noted energy developments.

In the marine area this model will be used to predict points of impact of oil pollution so that coastal protection and cleanup measures can be taken. It will also be used for Outer Continental Shelf drilling site decisions.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$779,000)**Rank No.**

Specific outputs of this activity will include the establishment of an accurate and consistent long term water quality baseline data for pollutants associated with specific developments with emphasis on western energy development; the development of an overview of the water quality baseline for the entire Upper Missouri and Colorado Rivers with data manipulated to bring out significant trends which can be correlated with energy development. This effort supports over 30 surface water monitoring sites in key areas and the analyses of these and of other water samples from on the order of 1,000 distinct sites. This in turn will be used for future water quality planning, regional development and siting decisions. The development of water quality monitoring guidelines for new technologies such as oil shale, coal gasification and liquefaction and associated pollutants. The development and evaluation of long term, regional water quality trends associated with regional energy development. In the marine area, a wind and current computer model is being developed to predict the path and location of marine oil pollution.

4

OUTPUTS FROM FIRST INCREMENT (\$280,000)**Rank No.**

Initiation of water monitoring and the acquisition of an accurate, consistent water quality baseline data at key sites in areas of the Eastern half of the U.S. where additional coal mining development is planned, especially where associated with planned coal combustion and conversion facilities. This will include areas of Illinois, Ohio, Kentucky and Tennessee and involves investigations, sampling and analysis at approximately 200 sites in these states. Evaluation of long term water quality trends at sites associated with developments in these areas will yield a relationship between the gradual degradation of water quality due to coal mining related pollution from present mining sites, and also the quantification of the degree of further degradation in water quality which would be caused by additional coal development in these areas.

40

OUTPUTS FROM ADDITIONAL INCREMENT (\$800,000)**Rank No.**

Establishment of a comprehensive regional energy related water quality network and acquisition of baseline data for major rivers and key tributaries along which new coal mining, coal combustion and conversion activity are underway and planned in the Midwestern and Southeastern U.S. This network will complement specific site analyses and existing stations by providing direct, sensitive measurements on a broad scale, regional basis for coal related pollutants in areas both near and distant to sources. Evaluation of long term, wide-area regional water quality trends associated with regional energy development will yield a relationship between the gradual degradation of water quality due to coal mining, combustion and conversion related pollution from existing and planned coal related development. Without such a regional baseline geared to pollutants from mining and from anticipated coal combustion conversion activity, there will not be an accurate past reference point from which to measure the changes in water quality when planned energy developments become operational in these regions.

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<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes & Effects Research	Measurement & Monitoring	Groundwater Monitoring

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>		<u>First Increment</u>		<u>Additional Increment</u>	
EPA	300,000	EPA	50,000	EPA	200,000
USGS	0	USGS	360,000	USGS	300,000
TOTAL		410,000		500,000	

STATEMENT OF PURPOSE

Strip mining of coal and conversion of oil shale will have significant effects on the availability and quality of groundwater, especially in the arid west. The purpose of this activity is to ensure that an adequate methodology is available for monitoring groundwater in these regions and to expand research studies of groundwater into areas earmarked for development or which are under development. The ultimate purpose is to provide the capability of detecting and measuring contamination of actual or potential drinking water and groundwater used for agricultural activities.

USE OF OUTPUTS

This activity is designed to provide both developmental and regulatory organizations with the methodology to accurately and consistently measure groundwater quality in the geological setting of the coal and oil shale deposits noted above; the assessments of baseline groundwater quality will provide a reference point from which future degradation can be measured and upon which pollution control and development limitation decisions can be based.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (300,000)

Rank No.

21

Specific outputs of this activity include the development of a comprehensive, area-wide groundwater monitoring methodology for oil shale and Northern Great Plains mining areas; also the assessment of groundwater quality baseline in several locales of the Western U.S. projected for coal or oil shale development.

OUTPUTS FROM FIRST INCREMENT (410,000)

Rank No.

32

This activity involves the testing of the groundwater monitoring methodology. In addition, a wide ranging series of shallow aquifer sampling studies will be carried out in Western and Eastern coal mining areas where new developments are planned. This is to document the character of present groundwater quality in key areas so that subsequent studies of degradation will be possible.

OUTPUTS FROM ADDITIONAL INCREMENT (500,000)

Rank No.

53

This activity will involve extension of the area-wide deep groundwater monitoring methodology to in-situ coal gasification demonstrations. This technology of its nature presents a potentially major impact on groundwater quality. Actual research monitoring will document area-wide effects during initial demonstrations of in-situ coal gasification.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes & Effects Research	Measurement & Monitoring	Land Use Monitoring

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>	<u>First Increment</u>	<u>Additional Increment</u>
EPA 225,000 NASA 225,000 TVA 0	NASA 355,000 TVA 100,000	None
TOTAL 450,000	455,000	

STATEMENT OF PURPOSE

Planned strip mining of coal (east and west) and development of oil shale will have significant effect on local and regional water quality. Up to date information on existing mining operations, drainage patterns, pollution control procedures, reclamation procedures as well as baseline information on pre-development areas is needed for regional planning and regulatory decisions at various levels. Overhead monitoring of surface developments provides data with the perspective and the periodicity required for information useful for regulatory purposes. The purpose of this activity is the gathering and interpretation of such data for the regulatory process.

USE OF OUTPUTS

This activity is designed to provide the means for regular, economical and comprehensive imagery coverage to Federal and state entities involved in energy development planning and pollution control activities. Long term coverage is designed to provide documentation and trend data on long term control and effects of mining pollution and on reclamation.

DESCRIPTION OF OUTPUTS FOR LOWER RUDGET (450,000)

Rank No.

19

Specific outputs of this activity include the development of an automated technique for the rapid gathering, analysis and interpretation of overhead data on strip mines in various type ecosystems; the establishment of a comprehensive annual imagery baseline which will document the progress of development and effectiveness of pollution control and reclamation measures. Emphasis is on major new coal strip mines and on expansion of existing mines in the western states, where the need for information on new developments, on the condition of existing mining operations and on reclamation activity is most critical for planning and regulatory decisions on water quality degradation from mines and from solid waste disposal and thermal pollution at power plants.

OUTPUTS FROM FIRST INCREMENT (455,000)

Rank No.

30

Extension of automated data interpretation techniques to parameters characteristic of eastern and midwestern mining operations and ecosystems.

Expansion of overhead data gathering research monitoring to areas of the southeast and midwest where major new mining and power plant activity is planned. This information is needed to document the array of energy related sources which contribute to regional water quality degradation and to despoiling potentially useful land.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

No additional increment

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes & Effects Research	Measurement & Monitoring	Measurements Quality Assurance

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>	<u>First Increment</u>	<u>Additional Increment</u>
EPA 350,000 NBS 806,000 NOAA 150,000 TVA 130,000	EPA 200,000 NBS 100,000	
TOTAL 1,436,000	300,000	

STATEMENT OF PURPOSE

All environmental measurement programs, especially those involving networks with numerous measurement locations and separate analytical laboratories, require standardized sampling, measurement and analytical procedures or data will vary widely. Conclusions based on such data will not be valid or defensible. The purpose of this activity is to provide such procedures, reference evaluations and standard reference materials to ensure validity of research monitoring activities in the program and to develop standard materials for pollutants from new technologies for use in future measurements programs associated with those technologies.

USE OF OUTPUTS

This activity is used to ensure the validity of all air and water monitoring projects within the program subcomponent; also, standard reference materials are being developed to be available for research and regulatory monitoring activities for various second generation energy technologies. Emphasis is on new hazardous compounds and complexes from these technologies.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,436,000)

Rank No.

5

Specific outputs of this activity include establishment of standard procedures, circulation of standard reference materials for pollutants, evaluation of analytical laboratories for air, water and marine research monitoring projects in energy/environment program; development of new standard reference materials for pollutants associated with second generation fossil fuel technologies.

OUTPUTS FROM FIRST INCREMENT (\$300,000)

Rank No.

41

Measurements quality assurance support for existing monitoring activities in the Southeastern and Midwestern U.S.; thereby creating a minimum, consistent, accurate regional baseline network where fossil fuel combustion and conversion plants are planned; this will provide a basis for subsequent regional air quality degradation studies. This support involves providing consistent sampling guidelines, instrumentation, calibration using reference materials relatable to national standards, laboratory cross-check analyses and evaluation of analytical laboratory performance. Without such quality control, the results from different monitoring stations will vary widely due to use of varying sampling and analysis methods among other factors. With quality control an array of sampling stations can produce intercomparable data, thereby producing an accurate air or water quality baseline over a broad region instead of sets of unrelatable data. The array of stations can then be truly classified as a regional network. This effort will involve EPA, TVA & USGS monitoring activities in energy intensive areas of the regions noted. Also, national standard reference materials needed for accurate calibration of instruments measuring organic water pollutants associated with coal gasification will be produced.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

No additional increment

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects Research	Measurements & Monitoring	Air Instrumentation

RESOURCE DISTRIBUTION BY AGENCY

FY-1978 Lower Budget		First Increment		Additional Increment	
EPA	420,000	EPA	200,000	EPA	300,000
ERDA	315,000			ERDA	200,000
NBS	75,000			NBS	200,000
NIOSH	241,000	NIOSH	100,000		
TOTAL 1,051,000			300,000		700,000

STATEMENT OF PURPOSE

In the area of conventional energy technology which is planned for expansion, there are a number of missing but key elements in measurement methodology for hazardous air pollutants. This is especially true for air pollutants formed in the atmosphere from energy related emissions. In the area of new fossil fuel combustion and conversion technologies there is a wide variety of pollutants for which ambient measurement does not exist or is inadequate. This is especially true of potentially hazardous organic vapors and aerosols. The purpose of this activity is to develop these measurement methods and instruments. Because such methods developments takes a number of years on the average, this activity is a pacing item for future atmospheric and epidemiological studies involving ambient measurements.

USE OF OUTPUTS

The outputs of this activity are needed in order that adequate atmospheric transport and transformation, epidemiological and baseline and trend monitoring studies can be initiated. It is essential that such studies involve direct measurements of specific energy related pollutants because inferred results are not adequate for the development of energy related pollution control measures, strategies, and compliance programs which will eventually be based on such studies. Adequate and valid measurement methods and instrumentation are basic and key elements which must precede accurate studies and valid pollution assessment control strategies.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,051,000)

Rank No.
12

The outputs of this activity include development of methods for measuring inorganic compounds from conventional and advanced energy technologies as distinct from simple elemental analysis; the development of real-time sulfur compound analyzers for airborne and ground-based studies; the development of mass/size distribution analyzer for airborne fine particulates and aerosols; the development of high sensitivity automated sulfur compound analyzer for handling hundreds of analyses per day; the development of a fibrous aerosol monitor; the development of a pocket sized, programmable multi-pollutant sampler for epidemiological studies, particularly in occupational environments.

OUTPUTS FROM FIRST INCREMENT (\$300,000)

Rank No.
38

1. The outputs associated with this activity are advanced sampling and analytical methods for research studies to accurately identify and measure the wide variety of organic vapors and aerosols associated with new energy technologies such as coal gasification and oil shale conversion at ambient air concentrations. Emphasis will be placed on potentially hazardous compounds formed in the atmosphere; this effort paces the level of sophistication which is possible in performing atmospheric transport and transformation studies associated with organics from these technologies.
2. A portable device for sampling multiple gases in occupational environments associated with energy production and fuel processing facilities. This device is geared to provide sensitive analyses of such gases at concentrations associated with occupational rather than environmental settings.

OUTPUTS FROM ADDITIONAL INCREMENT (\$700,000)

Rank No.
50

The development of advanced sampling and analytical standard reference methods for operational compliance monitoring of energy related air pollutants associated with expanding energy combustion and conversion technologies. Such devices must be engineered for endurance, accuracy of calibration in a limited range of sensitivity, as opposed to research and special study instruments whose development precedes operational devices. Effort will involve inorganic and organic pollutants but would emphasize potential hazardous organics or classes of organics for which present specific measurement methodology is non-existent.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects Research	Measurements and Monitoring	Water Instrumentation

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>		<u>First Increment</u>	<u>Additional Increment</u>
EPA	160,000	EPA	220,000
ERDA	112,000	ERDA	300,000
NBS	300,000	NBS	200,000
NOAA		NOAA	
USGS	380,000	USGS	80,000
TOTAL	952,000	300,000	500,000

STATEMENT OF PURPOSE

There is lack of sampling and analytical methods for measuring the multitude of water pollutants and classes of effluents associated with the mining of various types of coal in distinct locales (different compounds and sediment chemistry) as well as from liquid waste and leaching from solid waste associated with new coal combustion and conversion technologies and with oil shale processing. The purpose of this activity is to provide such methods and instrumentation. Because such methods development takes a number of years on the average, this activity is a pacing item for future water measurements studies related to specific energy related water pollutants and their effects.

USE OF OUTPUTS

The outputs of this activity are needed in order that adequate water transport and transformation and baseline and trend studies can be initiated. It is essential that such studies involve direct measurements of specific energy related pollutants because inferred results are not adequate for development of energy related pollution control measures, strategies and compliance programs which will eventually be based on such studies. Adequate and valid measurement methods and instrumentation are basic and key elements which must precede accurate and valid pollution assessment and control strategies.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$952,000)

Rank No.

13

The outputs of this activity include the development of techniques for analysis of toxic metals in mine drainage; analytical techniques for analyses of pollutants from liquid fuels from coal and oil shale; comprehensive report on low level, potentially hazardous contaminants from new energy technologies; development of analytical laboratory methods for selected contaminants from new technologies; the development of stream flow and gaging equipment for measuring stream and sediment in areas characteristic of western coal development; methods for analyzing toxic metals in sediments; and for measuring petroleum compounds in high volume samples.

OUTPUTS FROM FIRST INCREMENT (\$300,000)

Rank No.

39

1. The outputs of this activity will be the development of a comprehensive measurement methodology of associated sampling and analytical methods for hazardous organics in streams from new energy technologies. Emphasis will be on compounds which are potentially carcinogenic with low level, long term exposure. Furthermore, within these categories, organic compounds which are not relatively volatile cannot be measured adequately by existing analytical techniques. Therefore, the exploration of new analytical procedures will be involved in the development of such a comprehensive measurement methodology. These methods will be used for sampling and analyzing streams and bodies of water which will be subject to contamination, even at low levels, by new energy technology demonstrations and commercializing.
2. Sampling and analytical methods for crude oil contamination of marine and coastal waters associated with Outer Continental Shelf drilling.

OUTPUTS FROM ADDITIONAL INCREMENT (\$500,000)

Rank No.

51

The development of advanced sampling and analytical standard reference methods for operational compliance monitoring of energy related water pollutants associated with expanding coal and oil shale extraction and conversion technologies. Unlike research equipment, such devices must be engineered to operate for prolonged periods in a hostile (sludging, corrosion) environments; additional methods are needed for sampling and analysis of leach materials from solid waste from various advanced coal conversion technologies. Emphasis will be on potentially hazardous organics or classes of organics for which present measurement methodology is inadequate or non-existent.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Processes and Effects Research	Measurement and Monitoring	Remote Measurements Instrumentation

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Minimum Budget</u>		<u>First Increment</u>	<u>Additional Increment</u>
EPA	125,000	EPA	
NASA	66,000	NASA	100,000
NOAA		NOAA	190,000
TOTAL		290,000	

STATEMENT OF PURPOSE

Conventional chemical in-situ monitoring methods cannot provide complete measurements of area-wide ambient pollutant distribution, nor can they adequately track and measure atmospheric plume pollutant concentrations near the source under varying meteorological conditions, nor are they adequate for atmospheric transport and transformation studies of dispersed plumes at hundreds of kilometers from the source. There is a need for instruments to measure energy-related air pollutants in plume tracking and detection studies at short and long ranges, in measuring vertical pollutant distributions and in three dimensional pollutant mapping. The purpose of this activity is to provide accurate, long path, remote sensing instrumentation which will fill the measurement gaps in obtaining information which is needed for energy-related pollutant assessment, control and enforcement strategies.

USE OF OUTPUTS

Among the important near-term uses of such devices are those involving the unique capability to completely and directly measure energy-related pollutant distributions within large volumes of air to extended altitudes; this coupled with the ability to measure the movement and changing distribution of such pollutants from specific and complex, combined plumes makes information from such devices uniquely suited for pollution assessment in the development of local and regional pollution control strategies, siting decisions and enforcement programs; in many such cases, important advantages and economies are gained by combined use of remote sensing and conventional devices; significantly increased capability and overall economies are to be realized with such devices over current methods for source monitoring and enforcement programs.

DESCRIPTION OF OUTPUTS FOR MINIMUM BUDGET (\$191,000)

Rank No.

The major outputs of this activity are long-path light detection and ranging devices based on laser light emitting systems. For the minimum budget:

20

- . An aircraft-borne, down-looking device for measurement and tracking of particulate and fine plumes at distances of hundreds of kilometers from the source; for mapping in long-range transport studies.
- . A single device for sensitive measurement of several gaseous pollutants associated with fossil fuel plumes, including SO₂; for use as a multi-purpose compliance monitoring and siting tool for plume transport measurements at distances of several kilometers.

OUTPUTS FROM FIRST INCREMENT (290,000)

Rank No.

31

A long-path device for measurement of particulates due to power plant combustion and differentiated from natural or industrial fugitive dust at distances of up to 20 kilometers. This system will provide the initial basic calibration data required in less expensive versions which will be used for compliance monitoring of particulates. A compact, field prototype, long-path monitor for stack monitoring of SO₂; to be field tested as an enforcement device for SO₂ emission standard.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Health & Environmental Effects	Health	Identification of Hazards Agents

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>		<u>First Increment</u>	<u>Additional Increment</u>	
EPA	416	0	EPA	125
ERDA	663	0	ERDA	125
TOTAL	1079	0		250

STATEMENT OF PURPOSE

The objective of this activity is to identify hazardous materials associated with increased use of existing and new energy technologies using biological screening and testing systems to determine the presence of carcinogenic, mutagenic, teratogenic, and physiologically and metabolically toxic agents. Many of the agents which contaminate the products and non-economic residuals, to which workers and the general population will be exposed, have yet to be identified. It is not economically feasible to separate and test directly the toxicity of each and every agent produced during the various operations of a particular fuel cycle. The purpose of the present activity is to utilize simple, inexpensive and reliable biological assay systems to detect the presence of toxic components so as to reduce the number of expensive and time-consuming studies required to develop the quantitative dose-response relationships necessary for decisions regarding control systems development and/or rulemaking activity.

USE OF OUTPUTS

The output of this activity will be used by health researchers to prioritize the hazardous agents associated with energy technologies and design experiments to ascertain quantitative dose-response relationships for the potentially most hazardous substances. In addition, the data can be utilized by developers of energy technologies in making decisions regarding process modifications or improved pollution control systems. Failure to approve the activity will cause a reduction in the rate of obtaining data on effects of energy-related agents. The consequences of such an action would require commercializing new energy technologies with very large uncertainties in the health impact data base.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,079,000)**Rank No.**

The output of this activity will be published in a series of reports which will indicate:

- (1) The presence of known toxic materials associated with specific processes in the coal based energy cycles (conventional and advanced) and energy efficiency technologies (waste as fuel and building energy conservation) to which humans can be exposed.
- (2) The materials (compounds, mixtures, products, residuals, emissions, effluents, etc.) associated with the aforementioned processes which require more detailed examination of possible adverse biological effects in order to resolve the question of need for control for such processes.
- (3) The specific processes which apparently do not require additional study of the biological effects of associated materials.

Emphasis in the lower budget program is upon those energy systems whose prospects for commercialization appear to be near and intermediate term.

OUTPUTS FROM FIRST INCREMENT(\$250,000)**Rank No.**

The output from the additional increment will allow early preliminary estimates of the hazardous agents associated with energy technologies with longer term prospects for commercialization.

55

OUTPUTS FROM ADDITIONAL INCREMENT**Rank No.**

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Health & Environmental Effects	Health	Dose and Damage Indicators

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget \$K</u>		<u>First Increment</u>	<u>Additional Increment</u>
EPA	445	EPA	250
ERDA	690	ERDA	125
NIEHS	753	NIEHS	125
TOTAL		500	500

STATEMENT OF PURPOSE

The objective of this activity is to develop more rapid and sensitive biological methods to evaluate dose and damage to man arising from exposure to environmental agents.

The biological effects of hazardous agents on human population are dependent upon the rate and duration of exposure and integrated dose to the targets of concern (organs, tissues, cells, molecules, etc.). The purpose of this activity is to develop methods and techniques which can detect and quantify early, sublethal, repairable changes in the targets of concern, which are indicators of irreparable damage and also to quantify the dose that gives rise to the change detected.

USE OF OUTPUTS

The outputs will be used by health researchers to develop quantitative testing programs which are less time-consuming, complex and costly to increase the rate and the precision of screening methods that are presently available. The outputs will also be used to improve upon presently available diagnostic procedures so that early diagnosis can be coupled to remedial therapy and improve the prognosis of affected individuals. Failure to approve this activity will maintain the rate of acquisition of health effects data to the level limited by presently available screening techniques. In addition, the capability to produce quantitative data will be severely limited to macroscopic dosimetry and thus yielding information of questionable utility for understanding the damage and repair processes. Failure to develop dosimetry which is well related to repairable changes will limit detection of effects to changes which cannot be repaired.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,888,000)

Rank No.

10

The outputs of this activity will be a number of improved methods for more rapidly assaying the dose and accompanying damage to targets of concern for carcinogenic, mutagenic, teratogenic, and physiologically and metabolically toxic agents. Test systems under development and requiring validation cover a variety of targets (micro-organisms, mammalian cells, plants, insects and mammals) and a variety of end points; for example in the case of mutations - point defects, chromosomal effects, DNA repair for a gamut of agents. In vivo methods include investigation of modification of behavioral response, development of new test strains, and test organ grafts, modification of body fluids, lipids and proteins, as well as evaluation of organ system dysfunction. In vitro studies include evaluation of relative toxicity of specific cells (alveolar macropage, lymphocyte, fibroblast, epithelial cells).

OUTPUTS FROM FIRST INCREMENT (\$500,000)

Rank No.

34

The output from the first increment will be the preliminary development of a validated screening method which can yield early indications of sublethal repairable damage and which can be used in conjunction with human studies (clinical and/or epidemiological) e.g., detection of modification of learned behavior.

OUTPUTS FROM ADDITIONAL INCREMENT (\$500,000)

Rank No.

47

The additional increment will provide the data base necessary for the development of tools which will permit an assessment of body burdens (tissue levels) in man, plants and animals.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Health & Environmental Effects	Health	Metabolism of Hazardous Agents

RESOURCE DISTRIBUTION BY AGENCY

FY-1978 Lower Budget \$K		First Increment		Additional Increment	
EPA	440	EPA	220	EPA	250
ERDA	316	ERDA	100	ERDA	250
NIEHS	431	NIEHS	180	NIEHS	250
TOTAL		500		750	

STATEMENT OF PURPOSE

The objective of this activity is to determine the metabolism and fate of hazardous agents associated with energy technologies. The purpose of obtaining information on the rates of incorporation, routes of metabolism, products of metabolism, and deposition and turnover of hazardous agents is to permit development of risk assessment models, which specify tissues, organs, and/or functions at risk. In addition, such information on toxification/detoxification mechanisms is required in order to suggest alternative methods for modifying adverse impact of hazardous agents by modification of the metabolism and fate of agents with specific physical and chemical characteristics.

USE OF OUTPUTS

The outputs of this activity will be used by health researchers: (1) to improve the estimates of exposure and exposure rates of tissue, organs, cells and molecules of concern, and (2) to devise protective measures through modification of the exposure or exposure rate subsequent to ingestion, inhalation, injection or immersion. The data can also be used to design protective measures through modification of the physical and/or chemical attributes of the agent or class of agents which act against ingestion/inhalation or immersion modes of exposure. Failure to approve the program will require the development of estimate of risks to human health to be derived only from the macroscopic point of view. Such an approach is extremely costly, especially for obtaining information related to long-term exposures and responses requiring long periods to manifest themselves. In addition, the estimates of risk to human health based upon extrapolation of animal experimentation will be of questionable value without assurance that similarity of the animal model to human metabolism transformation, deposition, and toxification and detoxification has been established.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,187,000)**Rank No.**

The outputs of this activity will be published in a series of reports which convey⁹ how the various tissues under different initial conditions (stress, age, etc.) handle a particular agent or class of agents for the various modes of exposure (inhalation, ingestion, immersion).

The output of the lower budget program will be a series of reports dealing primarily with pulmonary deposition clearance, translocation, and cellular distribution of particulates, (trace elements and metallic oxides) and impact of joint action of agents (NO_x , SO_x) on lung metabolism. Studies on ingestion (gastro-intestinal) or placental barrier transfer rates of trace elements are addressed to a lesser extent as is the inhalation route for hydrocarbons.

OUTPUTS FROM FIRST INCREMENT (\$500,000)**Rank No.**

The outputs from the first increment will be data necessary to model the manner³⁵ and rate which organic vapors or organic materials adsorbed on inhaled particulates having a variety of levels of solubility in body fluids are transformed and transported to critical tissue components. This increment will also provide an opportunity to develop a model of the manner in which energy related organics (drinking water pollutants), are transformed and transported to critical tissue components.

OUTPUTS FROM ADDITIONAL INCREMENT (\$750,000)**Rank No.**

The second increment will permit the development of models of transformation and transport for energy related organics (products and waste streams) which interact through the immersion exposure route, e.g., skin painting, bathing, etc.

46

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Health & Environmental Effects	Health	Evaluation of Hazards to Man

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget \$K</u>		<u>First Increment</u>	<u>Additional Increment</u>	
EPA	1507		EPA	250
ERDA	1106		ERDA	250
NIEHS	1679		NIEHS	125
NIOSH	1739		NIOSH	125
TOTAL	6031			750

STATEMENT OF PURPOSE

The objective of this program effort is to improve the capability to quantitatively evaluate the short-term and long-term hazards to man of simultaneous exposure to a multiplicity of stressors primarily associated with energy technologies at differing levels and combinations for normal, susceptible and stressed population groups. The purpose of such activity is to reduce the uncertainties in the estimates of the quantitative dose-response relationships which are used to ascertain the need for regulatory action and/or control systems development.

USE OF OUTPUTS

This information will be used in the cost/risk/benefit analysis of various energy options to ascertain the need for regulatory action for all aspects of each energy system from resource extraction to energy utilization. Indications of the probable impacts on various population groups provide the type of information required for development of a regulatory strategy. This information will also be used to reevaluate and refine existing regulatory requirements. In addition, such data are required and utilized by the developers of energy technologies to modify processes and/or develop improvements in pollution abatement and control techniques to meet anticipated or prescribed regulations.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$6,031,000)**Rank No.**

The output of this activity will be published in a series of reports which convey the quantitative dose-effect relationships for energy-related stressors, both singly and in combination, and for early and late effects. Such outputs will include the development of improved models and concepts for extrapolation of the results of short-term exposures to estimate long-term (life-time) effects and for extrapolation of the data developed from animal experimentation to estimate the hazards to man. The outputs will include reports concerning human health studies (clinical, epidemiological) as well as animal toxicology studies. Emphasis is on dose-response relationships for adverse pulmonary effects (dysfunction, carcinogenesis) for air pollutants from increased coal combustion and near-term energy conservation technologies.

2

OUTPUTS FROM FIRST INCREMENT**Rank No.**

OUTPUTS FROM ADDITIONAL INCREMENT (\$750,000)**Rank No.**

The output from the additional increment will provide preliminary estimates of dose-response relationships for the ingestion exposure route (primarily drinking) for waterborne energy-related hydrocarbons and inorganics related to advanced fossil fuel technology development. Biological endpoints receiving special attention will be carcinogenesis and teratogenesis.

44

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Health & Environmental Effects	Health	Damage, Repair, Recovery Processes

RESOURCE DISTRIBUTION BY AGENCY

FY-1978 Lower Budget \$K		First Increment	Additional Increment
ERDA		ERDA	400
NIEHS	445	NIEHS	300
NIOSH	750	NIOSH	300
TOTAL		500	1000

STATEMENT OF PURPOSE

The objective of this activity is to determine the processes of damage, repair, recovery, protection and amelioration in biological systems which have been exposed to hazardous agents associated with energy technologies. The purpose of the studies of the nature of damage process at the molecular, macromolecular and cellular levels and the mechanisms of repair and/or recovery processes is to obtain information necessary to design specific remedial or protective measures for both the general and occupational population groups. Such information is also required to improve risk estimates by permitting more reliable extrapolation of data obtained from experiments with cellular or animal models.

USE OF OUTPUTS

The outputs will be used to reduce the uncertainties in their estimates of health risks of low level chronic exposure to energy-related agents individually and in combination. They will also provide information which will permit design and implementation of remedial procedures in the event of inadvertent exposure, e.g., removal of agents, cell replacement, etc. The outputs will be used by industrial hygienist to incorporate specific work practices and countermeasures for the energy-related industries. Failure to approve this activity will reduce the capability to protect from inadvertent exposures, and will require the use of data obtained from expensive and time-consuming experiments for estimates of hazards without any improvement in the reliability of extrapolation of the data. The occupational population groups (unions) may very well be unwilling to engage in the development and commercialization of new energy technologies where the health risks have such high uncertainty unless interim work practices and countermeasures are provided.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,195,000)

Rank No.

The output of the lower budget program will be published in a series of reports depicting how lesions are induced and repaired at the subcellular level of organization in biological systems for various energy-related agents, classes of agents, and their transformed products; and how such lesions are related to damage at higher levels of tissue organization. The outputs will also include work practices, documents and recommendations for engineering control countermeasures to protect the worker specific to energy technologies until sufficient data are available for occupational standards. The primary biological systems under investigation are the pulmonary, the hematopoietic and the immune defense systems. Results from preliminary industrial hygiene surveys for coal combustion, facilities amphibole production, and shale oil production will also be delivered.

OUTPUTS FROM FIRST INCREMENT (\$500,000)

Rank No.

The outputs from the first increment will include industrial hygiene surveys for coal gasification and coal liquefaction facilities, the generation of a "criteria" document for recirculation of air and recommended work practices documents for advanced fossil fuel production facilities.

Improved models regarding damage and recovery processes in the respiratory and immune systems will be developed.

OUTPUTS FROM ADDITIONAL INCREMENT (\$1,000,000)

Rank No.

The outputs from the additional element will be improved models of damage and repair processes occurring in biological molecules, most notably DNA, and amelioration procedures, e.g. utilization of chelating agents to remove the toxic agents from critical tissues.

PROGRAM INTEGRATION

ZZB DECISION ACTIVITIES - PROGRAM INTEGRATION

	75%		100%		125%	
	\$1,000	RANK	\$1,000 (41)	RANK	\$1,000 (42)	RANK
Integrated Technology Assessment	2,750	1	410	3	1,100	5
Technical Support	1,527	2	800	4		
	4,277		1,210		1,100	

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Program Integration		Integrated Technology Assessment

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>	<u>First Increment</u>	<u>Additional Increment</u>
\$2,750,000	\$410,000	\$1,100,000
TOTAL \$2,750,000	\$410,000	\$1,100,000

STATEMENT OF PURPOSE

The Integrated Technology Assessment program provides analysis of the environmental economic and social consequences of energy supply and use alternatives. These studies use the results of the environmental/energy program in evaluating trade-offs of energy production and pollution control alternatives. The program's aim is to synthesize research results to clarify the implications of energy and environment strategies on a regional and national basis. The three policy areas include the environmental consequences of alternative energy technologies or systems, the relative trade-offs among alternative environmental regulatory strategies and the trade-offs between economic consequences and environmental impacts.

USE OF OUTPUTS

The users of the results of integrated assessments are the Nation's energy policy makers. Because energy decisions are diversified throughout the private and public sectors, each assessment is designed to provide analysis to those interested in specific issues. The regional studies are germane to individual energy firms, local governments (i.e. municipal and county), state governments and federal resource managers (i.e. land managers, leasing officials, etc.). The national studies provide information to Federal agencies concerned in energy decisions. These include EPA, FEA, ERDA and DOI. The national studies also provide information and analysis to such private organizations as the Edison Electric Institute, the Electric Power Research Institute and the National Coal Association. Specific EPA users of energy policy analysis are the air and water regulatory functions.

<u>DESCRIPTION OF OUTPUTS FOR LOWER BUDGET</u>	<u>(\$2,750,000)</u>	<u>Rank No.</u>
--	----------------------	-----------------

1

- 1) Complete regional assessments: western (1978), Appalachian (1980) and Ohio basin (1980)
- 2) Complete national assessments: electric utility (1978), advanced coal systems (1979), oil import (1980).
- 3) Maintain interagency program schedules.

The lower budget will allow only a simple definition of issues and issue analysis. A follow-on effort to incorporate user comments and perform reanalysis will be curtailed.

<u>OUTPUTS FROM FIRST INCREMENT</u>	<u>(\$410,000)</u>	<u>Rank No.</u>
-------------------------------------	--------------------	-----------------

3

- 1) Complete regional assessments: western (1978) Appalachian (1979), Ohio basin (1979).
- 2) Complete national assessments: electric utility (1978), advanced coal systems (1979), oil imports (1980).
- 3) Expand scope of electric utility assessment to include (1) mining, processing and transportation, (2) water consumption and quality and (3) fluidized bed combustion.
- 4) Maintain interagency program schedule.

The first increment will be used to speed the completion of two regional studies and the advance coal system assessments. The electric utility study will be expanded to include all parts of the coal processing system and water use questions.

<u>OUTPUTS FROM ADDITIONAL INCREMENT</u>	<u>(\$1,100,000)</u>	<u>Rank No.</u>
--	----------------------	-----------------

5

- 1) Complete regional assessments: western (1978), Appalachian (1979), Ohio basin (1979).
- 2) Complete national assessments: electric utility (1978), advance coal system (1979), oil imports (1979).
- 3) Expand efforts to incorporate comments on regional and national studies to define issues for reanalysis, e.g. coal transportation and sulfur regulations, water consumption and "beneficial consumptive use."
- 4) Initiate an additional regional ITA study of either the Northeast or the Gulf Coast.
- 5) Expand interagency integrated assessment program to include a forum for review and evaluation of modeling techniques and data sources.

p.110 The resources of the second increment allow the integrated assessment program to assure the effective communication of the results of analysis and to re-evaluate specific questions raised by users. A part of this process would include a mechanism for comparing and evaluating energy policy models and data basis use by all Federal agencies.

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Program Integration		Technical Support

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 Lower Budget</u>	<u>First Increment</u>	<u>Additional Increment</u>
\$1,527,000	\$800,000	
TOTAL \$1,527,000	\$800,000	

STATEMENT OF PURPOSE

The purpose of this program is three-fold. First, it provides the entire 17-agency, \$100 million per year Interagency Program with standard management information support. Second, it produces quick-response studies under extreme time constraints as input into major program plan and policy activities. Third, it provides an extensive information transfer function to assure that the technical information and expertise generated by the Interagency Energy/Environment R&D Program is available in usable form to energy decision-makers and the interested public.

Decisions affecting the Nation's energy future are now and will continue to be made by a wide variety of private and local, state and Federal organizations. The technical support activity is designed to help assure that the technical expertise and information generated by the Interagency Energy/Environment Research program is available to energy decision makers and other interested persons. In addition, the activities sponsored with these resources help to bring information on the status of energy programs and policies to environmental researchers and research planners.

USE OF OUTPUTS

There are three types of output from this program: Management information, special policy studies and executive reports. The management information is used to monitor projects, report on exceptions, track milestones, and assure program continuity. The special policy studies are used to help plan resource allocations with regard to state-of-the-art energy issues and associated developing environmental concerns. The executive reports are used to inform private and public decision makers, on the salient alternatives associated with technological, regional, economic and social energy/environment and industry/environment developments.

The first two types of output (management information and policy studies are used mainly by EPA and Interagency Program research managers and planners. The third (executive reports) are used by a full spectrum of individuals from research managers to the concerned public. In addition to these major types of output, the program employs several other mechanisms, ranging from cooperative, regionally oriented R&D projects to development of scientific data for regulatory functions, to provision of expert witness testimony and the conduct of conferences and seminars. Users of these forms of information transfer include the representatives of the 17 agencies in the program, federal regional officials, state officials and private individuals interested in Federal energy- and industry-related activities.

DESCRIPTION OF OUTPUTS FOR LOWER BUDGET (\$1,527,000)

Rank No. 2

Conduct a major review of the Interagency Program. The review will involve all of the research managers from the 17 Federal agencies and will produce a documented set of major achievements, corrections and new initiatives for the Interagency Program.

Publish several management information reports which will comprise a compendium of research project, resource allocation and milestone status reports.

Publish six executive summary reports on energy related environmental R&D topics.

Produce six special policy-level reports for in-house resource planning and interagency program use.

Support energy/environment information transfer with two EPA regions.

Produce three special policy-level reports for in-house resource planning and Interagency Program use.

OUTPUTS FROM FIRST INCREMENT (\$800,000)

Rank No. 4

Produce four executive summary reports on energy/environment and energy-related environmental R&D topics.

Produce documentation, on project-by-project level, of entire FY-1977 Interagency Program. Provide the same for the entire industrial program.

Support energy/environment R&D information transfer with two EPA regions.

OUTPUTS FROM ADDITIONAL INCREMENT

Rank No.

No additional increment.

SECTION III - CONGRESSIONAL BUDGET OFFICE REVIEW

STAFF DRAFT ANALYSIS

ENERGY RESEARCH AND DEVELOPMENT PROGRAMS OF THE
ENVIRONMENTAL PROTECTION AGENCY: A Pilot Test of Zero-
Base Budgeting in a Legislative Framework
Volume I
Analysis

Prepared by
Edward H. Rastatter

Natural Resources and Commerce Division

CONGRESSIONAL BUDGET OFFICE

THE CONGRESS OF THE UNITED STATES

March 1977

PREFACE

This report, on a pilot test of the application of zero-based Budgeting (ZBB) in a legislative framework, was prepared at the request of the staff of the Senate Appropriations Committee. The test, on the energy/environmental programs of the Environmental Protection Agency (EPA), is one of four pilot tests being performed on aspects of the fiscal year 1978 budget, two for the Senate Appropriations Committee and two for the House Appropriations Committee, all with staff support by the Congressional Budget Office (CBO).

In keeping with the mandate of the Congressional Budget Office to provide objective, nonpartisan analysis of budget issues, this report contains no policy recommendations. The budget options presented in this report do not represent policies advocated by the Congressional Budget Office. They are simply alternatives chosen to illustrate the broad range of options available to the Congress.

The report was prepared by Edward H. Rastatter of CBO's Natural Resources and Commerce Division, with important contributions by Richard M. Dowd, under the direction of Nicolai Timenes, Jr.

The report could not have been prepared, nor the exercise conducted, without the wholehearted cooperation of EPA staff, notably Dr. Stephen J. Gage, Deputy Assistant Administrator for Energy, Minerals and Industry Research. However, EPA has not reviewed this report and thus is not responsible for its contents.

For ease of handling, the appendices to this paper are in a separate volume.

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SUMMARY

Zero-base budgeting (ZBB) is a budgeting system which forces the scrutiny of all budget dollars requested -- not just the increase over the previous year's level. It does this by, first, breaking down agency programs into specific activities and relatively small funding increments, and then forcing successively higher levels of management to rank these "decision packages" in the order of their importance. Decision makers can then set overall budget levels with an informed judgment that they are adding funds for the highest priority tasks and cutting out relatively low priority ones.

The ZBB technique was applied experimentally to the energy-related environmental research and development account of the Environmental Protection Agency (EPA) in response to a request of the Senate Appropriation Committee. The information and insights surfaced in this experiment enabled the development of a number of alternative strategies the Committee may wish to examine vis-a-vis the President's 1978 budget request. The five alternative strategies fall into two broad categories - two which alter the 1978 request by plus and minus \$10 million using the EPA priorities; and three which alter the request by overriding the EPA priorities with moderate or fundamental changes in priorities as seen by the Committee.

Budget Strategies using EPA priorities but alternative budget levels.

A reduction of \$10 million from the 1978 Request, although affecting

many of the funded activities, would focus on two general areas. For control technology it would substantially reduce efforts in assessing and developing environmental methods to deal with new energy technology (waste, synthetic fuels, and geothermal sources). For health and ecological effects much of the reduction would be for efforts designed to improve knowledge of the causes, quantities and impacts of hazardous organic compounds.

An increase of \$10 million over the 1978 request work would increase the efforts in control technology toward new technology at the commercial scale and, in the Health and Ecological effects area, it would increase national pollutant data and interpretive results of emissions upon ambient levels and human health.

Budget Strategies which override EPA priorities.

Adding back the \$4 million reprogrammed from control technology in the 1978 Request would increase and accelerate efforts toward understanding some of the newer technology both for generating energy from coal and for controlling pollutants from coal combustion.

A reduction of \$4 million for Health and Ecological Effects would mean foregoing the same outputs as those under the strategy of reducing the budget overall by \$10 million. This would result in a reduction in effects designed to improve knowledge of the causes, quantities, and impacts of hazardous organic compounds and, in addition, foregoing development of a validated screening method for early indication of sub-lethal effects and development of a model for predicting weather effects as a result of cooling tower plumes.

Adding \$5 million specifically earmarked for the long-term research widely considered under-represented in the EPA program would increase efforts on the long term health effects of energy sources, baseline air quality information, and the characterization of emissions from fluidized combustion. In the control technology area, efforts in coal cleaning would be increased.

Lessons learned from the ZBB experiment.

There were clearly benefits from the experiment, both to the agency in forcing it to examine its program for the outputs produced, the interactions among them, and their relative priorities; and to CBO for the better understanding of the account that it engendered. The experiment's usefulness to the Committee only it can judge.

However, the experiment was extremely time-consuming, and the "success" of any wider-scale ZBB effort would be heavily influenced by the account(s) involved and by the cooperation of the agency, which is, in turn, a strong function of what it perceived the results were on its appropriation level. Finally, in order to be well-done, a wider-scale ZBB effort may require production of far more detail than could be usefully perused by the Committee.

REQUEST

In November 1976 CBO was approached informally by staff members of the Senate Appropriations Committee, about the possibility of performing an experiment with "zero-base budgeting" (ZBB). In spite of the publicity surrounding ZBB and its apparently growing popularity for use in the business community and in 12-15 state governments, attempts to implement ZBB at the federal level have been limited to an abortive attempt in the Department of Agriculture in the early 1960s. (Not that analytical attempts to examine the "base" of the federal expenditures have not been undertaken: the planning-programming budgeting system (PPBS) of the 1960s and management by objectives (MBO) of the early 1970s are examples of government-wide efforts.)

ZERO-BASE BUDGETING

ZBB is a budgeting system which forces the scrutiny of all budget dollars requested, not just the increase over the previous year's budget level (which, under traditional budgeting, is implicitly treated as inviolable).

The ZBB procedure used in this experiment follows generally that outlined in Peter Pyhrr, Zero-Base Budgeting; however, some of Pyhrr's analytical trappings were not included (benefit cost comparisons,

alternatives, etc.) because we did not believe they could be performed credibly in time for this exercise to be useful.

The two steps to ZBB are (a) development of "decision packages" and (b) ranking them by priority.

Decision packages, developed by lower-level managers, are meant to identify discrete activities which will produce specific outputs, at various levels of funding. For example, activity A, if funded at a base level of \$100,000, will enable monitoring of, say seven pollutants in three rivers; an additional \$25,000 will fund monitoring of two additional rivers, while a further \$15,000 will fund monitoring of still two more rivers. Each of these three funding increments for activity A constitutes a "decision package".

After each of the agency's activities is broken down into similar decision packages, higher levels of management "rank" the packages in order of importance. In this way base level packages are forced to compete for scarce dollars with higher-level increments, since the agency may well consider high funding levels for certain activities more important than even base level funding for others. Thus, the end product of the ZBB exercise is a menu of specific outputs in decreasing order of priority. Its usefulness in this particular experiment is that the Committee can not only see what outputs result from the President's Request, but also the outputs which would be added or foregone by appropriation of more or

less than the request. An additional feature is that oversight committees will have a specific list of outputs to be compared with actual performance in later time periods.

WHY THIS ACCOUNT?

After extensive discussion, the EPA Energy Research and Development account was chosen for the experiment for several reasons. The account is relatively discretionary both in nature and level of effort, compared to say, Enforcement. Agency officials were eager to participate in order to raise the level of debate in the Congress over appropriation levels. Finally, a major reason was that the account was easily broken down into fairly discrete activities or tasks which could be "costed out" at various levels of effort.

ORIGINS

The history of this account is relatively recent and coherent. In June, 1973, the President directed the Chairman of the Atomic Energy Commission to prepare recommendations for an integrated energy research and development program for the Nation. The Chairman enlisted the assistance of an interagency task force and, in December 1973, completed and forwarded her recommendations in a report "The Nation's Energy Future". That report formed the basis for a number of budgetary and program decisions regarding technologies for energy production, conversion, and use.

In the process of preparing their recommendations, it became clear to the task force that there would be an additional requirement for research to identify the environmental effects of the new technologies, and to develop techniques for mitigating those effects. As a result, funds were included in EPA's fiscal year 1975 budget request for such purposes, and the Office of Management and Budget and the Council on Environmental Quality established two interagency working groups to analyse environmental R&D requirements and to recommend how Federal funds requested through EPA should be allocated.

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KING-MUIR AND GAGE REPORTS

The activities addressed by this report stem from those included in the recommendations contained in those task force reports, commonly referred to as the King-Muir Report^{1/} and the Gage report.^{2/} These reports were developed by key representatives of more than a dozen federal agencies, departments, and laboratories, all involved in energy-related environmental research. One of the major purposes of the reports was to determine whether serious gaps existed in the overall Federal Energy/Environmental R&D Program. By performing a cross-cut review of the entire program it was possible to identify such gaps, to determine areas where adequate support was available for national energy goals, and to locate target areas for funding via the special EPA energy appropriation.^{3/}

TRANSLATION INTO "DECISION PACKAGES"

The activities recommended in King-Muir-Gage were translated, by EPA staff, into a series of 39 discrete sub-tasks (attached as Appendix A) for which EPA either serves as the funding agent for an interagency effort or performs the task itself.

1/ Report of the Interagency Working Group on Health and Environmental Effects of Energy Use. 1974.

2/ Final Report of the Interagency Working Group on Environmental Control Technology for Energy Systems. 1974.

3/ Beginning with fiscal year 1977, energy R&D activities were merged with other R&D into a single R&D account.

Funding increments for each sub-task were determined (by EPA staff). "Base level" is the minimum level ("critical mass") below which the particular task might as well not be funded; if such a level could not be identified, it was set at approximately 25 percent less than the fiscal year 1978 Budget Request. The "first increment" above the base level is that amount necessary to bring the total up to the 1978 Request.^{4/} The "additional increment" is what the agency would like to see appropriated in the absence of budget constraints, but with the total of all "additional increments" constrained to sum to not more than 25 percent more than the 1978 request. Appendix B contains an example of the write-up of a decision package. The full set of decision packages, totalling some 87 pages at 2 to 4 pages per sub-task, is not included in this report.

RANKING OF DECISION PACKAGES

It is important that all ranking of decision packages be done by the agency itself, unless expertise exists elsewhere to overrule (some of) the agency's priorities. In this experiment, EPA initially agreed to rank its decision packages in three separate rankings: one set of priorities for Health and Environmental Effects, one set for Environmental Control Technology and another for Program Integration. EPA felt it was unable to develop one larger set of

^{4/} President Ford's request. Details of President Carter's recommendations were not available in time to be examined in this report.

priorities by combining all the decision packages of the three.

However, the EPA staff were able to do so for a critical subset of decision packages in the range of \$10 million above and \$10 million below the 1978 request.

In the EPA 1978 budget request, the Congress is being asked to appropriate a specific amount for energy R&D, \$96,427,000. The justification materials contain some narrative information concerning what was accomplished with the 1976 appropriation, what studies and projects are currently being supported with the 1977 appropriation, and what studies and projects will be begun, continued, and/or completed with the 1978 amount requested. Following the usual budget format, the material does not stress a sense of agency or national priorities, nor (is) any notion of what projects will be cut back or expanded if a different amount is appropriated. The Appropriation Committee can ask EPA witnesses, of course, what actions the agency will take in such a situation, but there is ordinarily no formal mechanism for developing answers in advance. Consequently, any changes the Committee makes to the appropriation request will, of necessity, be developed largely in the absence of formal recommendations from the agency or the agency's evaluation of the consequences.

A principal use of prioritized decision packages in the ZBB framework is to permit higher management levels (in this instance the Appropriations Committee) to examine the budget level proposed for the program under review in light of the competition for budgetary resources from other, different programs. In particular,

5

ZBB is designed to elicit information on what would be sacrificed or gained, in terms of substantive accomplishment, at different levels of funding. To illustrate this use of ZBB, two alternative budgets are developed, one at \$10 million less than the President has requested, and one at \$10 million more. Note that, in showing outputs added or foregone, the priority ranking established by the agency is assumed. Changes to those priorities are considered in the next chapter.

\$10 million reduction from the 1978 Budget Request.

The Committee may decide that the appropriation should be less than the request. Table 1 below shows how, using EPA priorities, reductions of up to \$10 million from the request would be distributed among the activities carried out in the energy R&D account. Appendix C contains a detailed list of the specific outputs which would be foregone in the event of such reductions.

The results of a \$10 million reduction would be to cut about \$5.6 million from the control technology program, about \$3.2 million from the Health and Ecological Effects program, and about \$1.2 million from Program Integration.

Outputs that would be foregone in control technology would include: accelerating the environmental assessment of processes for high BTU synthetic gas from coal and evaluation of associated treatment methods; performing feasibility studies of several alternatives to convert solid waste into fuel; expanding a pilot demonstration on

TABLE 1. DISTRIBUTION OF REDUCTIONS UP TO \$10M FROM 1978 REQUEST

Program Activity	Program Component a/	Incremental Amount (\$K)	Cumulative Budget (\$M)
Metabolism of Hazardous			
Agents	HE	500	86,416
Waste-as-fuel	CT	1,200	86,916
Synthetic fuel (shale)	CT	400	88,116
Advanced Energy Systems	CT	300	88,516
Damage/Repair/Recovery	HE	500	88,816
Atmospheric Transport and Transformation	HE	1,000	89,316
Integrated Technology Assessment	PI	410	90,316
Waste and Water			
Pollution Control	CT	1,133	90,726
Air Instrumentation	HE	300	91,859
Water Instrumentation	HE	300	92,159
Water Monitoring	HE	280	92,459
Technical Support	PI	800	92,739
Synthetic fuel (coal)	CT	1,788	93,539
Oil and Gas Extraction	CT	500	95,327
Industrial Energy			
Conservation	CT	300	95,827
Quality Assurance	HE	300	96,127
	1978 Budget Request		96,427

a/ HE = Health and Environmental Effects; CT = Control Technology;
PI = Program Integration

disposing of flue gas desulfurization wastes and additional pilots on cooling water systems; adding one more pilot plant for shale oil pollution control; developing and evaluating several methods to avoid and clean up oil spills; developing baseline data on the disposal of geothermal fluids; and associated ground water and integrating several energy conservation and pollution control methods.

The outputs foregone in health and ecological effects would include: adding an additional six field studies to determine the causes of hazardous atmospheric organics from advanced fossil fuel facilities and base line studies on the levels of hazardous organics in one region; gathering data on the paths by which inhaled organics are transmitted to critical tissues and modelling how ingested organics are transmitted to critical tissues; performing industrial hygiene surveys and developing exposure criteria for coal gasification and liquefaction pollutants; developing new methods for measuring hazardous organic compounds in the air and in water in an industrial environment, and for determining crude oil contamination in coastal and marine waters; adding 200 water monitoring sites for baseline data in the Eastern U.S.; and providing standards and guidelines for monitoring in the Southwest and Midwest regions.

Outputs foregone in Program Integration would include: accelerating two regional studies and expanding the electric

industry study to include all parts of the coal system; and providing for dissemination and documentation of many of the results of the program for fiscal 1977.

The total reduction, although covering many of the programs, would focus on two general areas. For control technologies it would substantially reduce efforts in assessing and developing environmental methods to deal with new energy technology (waste, synthetic fuels, and geothermal sources). For health and ecological effects much of the reduction would be for efforts designed to improve knowledge of the causes, quantities, and impacts of hazardous organic compounds.

\$10 Million Addition to the 1978 Budget Request

Conversely, the Committee may decide that the 1978 request for this account is insufficient believing that, with the great rush to accelerate supplies of energy from new and existing sources, additional funds should be appropriated to monitor and abate the environmental consequences. Table 2 shows how, using EPA priorities, additional funds of up to \$10 million would be applied. Appendix D contains a detailed list of the specific outputs which could be produced by EPA in the event of such additions.

The results of such an addition would be to add about \$5.2 million to control technology efforts and about \$4.7 to health and ecological effects and integrated assessments. The outputs that would be obtained from control technology would accelerate

TABLE 2. DISTRIBUTION OF ADDITIONS UP TO \$10M to 1978 REQUEST

<u>Program Activity</u>	<u>Program Component a/</u>	<u>Incremental Amount (\$K)</u>	<u>Cumulative Budget (\$K)</u>
		1978 Budget	
		Request	96,427
Fluidized Bed Combustion	CT	714	97,141
Air Monitoring	HE	1,000	98,141
Water Monitoring	HE	800	98,941
Integrated Technology			
Assessment	PI	1,100	100,041
Flue Gas Desulfurization	CT	1,631	101,672
Coal Cleaning	CT	1,353	103,025
Evaluation of Hazards			
to Man	HE	750	103,775
Damage/Repair/Recovery	HE	1,000	104,775
Nitrous Oxide Control	CT	1,500	106,275

a/ HE = Health and Environmental Effects; CT = Control Technology;
PI = Program Integration

development of controls for various pollutants including direct sulfur removal from stacks, coal cleaning and modification of combustion methods as well as to assess the costs and benefits of various specific flue gas desulfurization devices and to develop alternatives to slurry pond disposal. In the health and ecological effects area the output would include an increase in air monitoring sites near potential energy facilities; gathering water quality baseline data in additional regions (Midwest and Southwestern); an assessment of the impact of energy facilities on regional water quality; preliminary dose-response data for the impact of water-borne hydrocarbons upon human health; and improved models depicting the impact of pollutants on specific biological molecules such as DNA, along with repair processes. The Integrated Technology Assessment outputs would include accelerating by one year a national assessment of oil imports, initiating a regional assessment (Northeast or Gulf Coast) and evaluating and disseminating results of various models and assessments. Thus the control technology work would increase the efforts toward new technologies at the commercial scale and the Health and Ecological effects would increase national pollutant data and interpretive results of emissions upon ambient levels and human health.

While the above budget strategies build on possible changes to the level of the President's request for the environmental R&D program using EPA priorities, the Congress may wish to override those priorities and specify its own. One of the features of ZBB is that outputs and objectives should be sufficiently specified by lower level experts that successively higher levels of decision-makers may re-rank decision packages on the basis of good information but a better understanding of overall national priorities. Such strategies, several of which are outlined below, could go to the mix, as well as the level, of this program.

Moderate reordering of priorities. A number of strategies are available which would alter the relative budget amounts devoted to control technology and health and environmental effects, but would accept the stated EPA priorities within those categories.

The 1978 request reflects an added \$4 million for health and environmental effects as requested by EPA, but financed, in effect, by a cut of that amount for control technology. As an example of reordering of priorities, the committee might add back that cut, resulting in a total level just over \$100 million and the following additional outputs: 1/

1/ See Appendix D for the specific outputs associated with these sub-tasks.

\$ 714,000	Fluidized Bed Combustion
\$1,631,000	Flue Gas Desulfurization
\$1,353,000	Physical/Chemical Coal Cleaning

The outputs added for control technology would be those C.T.'s added in the strategy sketched out earlier of increasing the total budget by \$10 million. These would increase and accelerate efforts toward understanding some of the newer technologies both for generating energy from coal and for controlling pollutants from coal combustion.

As another example, Health and Ecological Effects might be reduced by \$4 million. This strategy could stand by itself or be used in conjunction with the previous strategy (the latter would essentially reflect and reaffirm not only the 1977 budget level but also the relative distribution of funds between control technology and health and ecological effects as originally requested by EPA). Under this strategy, the following outputs would be foregone: 2/

\$ 300,000	Quality Assurance
\$ 280,000	Water Monitoring
\$ 300,000	Water Instrumentation
\$ 300,000	Air Instrumentation
\$1,000,000	Atmospheric Transport
\$ 500,000	Damage/Repair, Recovery Processes
\$ 500,000	Metabolism of Hazardous Agents
\$ 500,000	Dose and Damage Indicators
\$ 135,000	Weather Modification

2/ See Appendix E for a list of the specific outputs forgone from this reduction.

The outputs foregone in this strategy would include those for Health and Ecological Effects in the strategy of reducing the budget over all by \$10 million. This would result in a reduction in efforts designed to improve knowledge of the causes, quantities, and impacts of hazardous organic compounds; to develop a validated screening method for early indication of sub-lethal effects, and to develop a model for predicting weather effects as a result of cooling tower plumes.

Fundamental reordering of priorities. Virtually unlimited possibilities exist, of course, for a Congressional reordering of priorities among all the decision packages. One illustrative strategy is outlined here. Some critics of EPA feel that the R&D budget is treated as an emergency source of cash for financing responses to unanticipated crises such as that involving Kepone. Others feel strongly that EPA is devoting too small a proportion of its budget to truly long-term research projects. As the Office of Technology Assessment says in a recent report: 3/

The Environmental Protection Agency (EPA), in presenting to Congress for the first time a 5-year Plan for Environmental Research and Development activities, has taken an important step toward expanding the public dialog necessary to identify and establish national environmental goals. Short-

3/ "A review of the U.S. Environmental Protection Agency Environmental Research Outlook: Fiscal Year 1976 through 1980", August 1976, p. 1.

comings in the initial EPA R&D Plan serve notice of potential issues which must be resolved if EPA is to continue to effectively and authoritatively perform its mission of protecting environmental quality for both present and future generations. Foremost among the shortcomings in the R&D Plan is EPA'S failure to indicate a commitment to long-range research and, as a corollary, an excessive focus on short-term R&D issues related directly to the enforcement and or achievement of EPA's current regulations. Accordingly, the Plan emphasizes the development and demonstration of control technologies. In many cases, however, the large problems involve social, economic, and institutional patterns which not only impede technical solutions but which require nontechnical approaches. To develop effective overall environmental management strategies will require more systematic and sustained socioeconomic research efforts than those specified in the Plan. An added R&D emphasis on long-range environmental concerns and a more responsive role to its line responsibility as coordinator of Federal environmental R&D would do much to enhance EPA's effectiveness and credibility.

One strategy which would address these concerns would be to appropriate an amount exceeding the request by, say, \$5 million and earmarking it for such essentially long-term sub-tasks as: 4/

\$ 800,000	Evaluation of Hazards to Man
\$1,000,000	Damage/Repaid/Recovery Processes
\$ 714,000	Fluidized Bed Combustion
\$1,353,000	Coal Cleaning
\$1,000,000	Air Monitoring

By earmarking an additional \$5 million for long-term research, somewhat more than half would go to health and ecological effects, and the rest to control technology. The Health and Ecological effects program would provide funds for making preliminary esti-

4/ See Appendix D for the specific outputs associated with these sub-tasks.

mates of the dose-response relationship for water-borne hydrocarbons, developing improved models of damage and repair processes in biological molecules such as DNA, and for a major increase in the number of air monitoring sites in areas where new energy facilities are probable.

In control technology the increased outputs would speed the gathering of data on pollution control for fluidized bed combustion, develop alternatives to slurry pond disposal, and to combine coal cleaning and flue gas desulfurization. These outputs would thus increase efforts on long-term health effects of energy sources, baseline air quality information, and expand the effects for two likely fossil fuel preparation methods, coal cleaning and fluidized beds.

Several observations about the application of zero-base budgeting in the legislative process emerge from this experience.

HOW THIS EXPERIMENT DIFFERS FROM OTHER RECENT FEDERAL
ZBB EXPERIMENTS

Three other ZBB experiments at the federal level have been undertaken recently, one under the sponsorship of the Senate Appropriations Committee and two under the sponsorship of the House Appropriations Committee. Table 3 compares the approach of the different experiments on a number of points. As Table 3 shows, the EPA experiment was somewhat closer to the formal ZBB technique than the others. The Consumer Product Safety Commission (CPSC) was not quite as close in approach because the agency did not rank its decision packages, but the experiment comprised the entire agency whereas the EPA experiment applied to a relatively small portion of the agency's budget.^{1/}

As the NASA experiment progressed, it became apparent that a formal ZBB review would be difficult to accomplish. As a result, the experiment now takes the form of an attempt to provide a detailed breakdown of what is being done in its Research and Program

^{1/} CPSC believed its "programs were too interrelated" and that there was "no management information system" which would support such ranking.

TABLE 3. COMPARISON OF ZBB EXPERIMENTS

	EPA	CPSC	NASA	HUD
Sponsor	Senate	House	House	Senate
% of agency budget involved	5.2	100.0	22.7	0.3
ZBB concepts used:				
alternative budget levels employed for individual program components	yes	yes	no	no
decision packages developed	yes	yes	no	no
decision packages ranked	yes	no	no	no
benefit-cost analyses developed	no	no	no	no
alternative budget strategies developed	yes	no	no	no

Management (R&PM) account. In part, this situation arises because of the close relationship of NASA's R&PM and R&D accounts and the importance of the ongoing shuttle to both. Although detailed justification is provided for new starts, no alternative budget levels or relative priorities are developed.

The HUD experiment ran into early data problems; consequently, any further analytical work will be outside the ZBB framework.

Benefits

There clearly were a number of benefits, to a variety of participants in the process. EPA acknowledges that the pilot test forced the agency to consider seriously what the outputs of its energy R&D activities are, how they interact, and what relative priorities it attaches to them. We believe this conclusion was strongly influenced by, and influenced, the very positive attitude EPA brought to the experiment.

CBO probably learned more about the program than it could or would have from standard budget justification material, because the presentation of ZBB decision packages provided information which led almost automatically to a series of fundamental questions relating to the underlying design of the program.

Whether the results will prove useful to the Committee only it can judge; however, there clearly has been created a new flow of information which could markedly alter the shape of the debate over the appropriations for this account.

These results were not achieved without cost.

Design of the Test

The legislative environment at the Federal level differs markedly from the executive environment at the State level, and this difference requires almost a fundamental redefinition of zero-base budgeting if the needs of the Committees are to be met. In this test, the zero-base concepts outlined by Pyhrr were taken as a conceptual framework or point of departure to be tailored to the particular requirements of the EPA energy R&D account, and not as dogma to be followed slavishly.

An important initial consideration is the selection of the account to be zero-based. The energy portion of the EPA R&D account seemed a reasonable choice, being a reasonably homogeneous program which can be considered in isolation. And yet the program does not stand alone; it is driven in large part by decisions on the energy-producing technologies chosen for support in research programs of other agencies, notably ERDA; and, moneys from this account are passed through to other agencies to support work which is closely related to their mission. Rare is the Federal program which serves only one objective or constituency; yet there is at least an implicit assumption in ZBB that the objectives underlying a program to be zero-based can be uniquely defined.

The level of aggregation is very important to the success of the zero-base effort. A first decision on level of aggregation is implied by the choice of the account to be zero-based. (Had one

chosen all of EPA, all EPA R&D, or just Control Technology, the exercise would have looked quite different). Once that decision has been made, however, the decision on sub-tasks is important. In the present instance, 39 sub-tasks were identified, and decision packages developed at three levels of funding for each. That level itself is a compromise, which seemed to work reasonably well. However, its utility will be determined in part by the amount of time the Committee can allocate to review of this account. If the Committee has little time, then a relatively high level of aggregation would be appropriate. On the other hand, applications of ZBB at the State level are based on decision packages of extreme detail--far more detailed than any examined in this test. The level of detail clearly influences the effort involved as well as the insight gained from the exercise.

Effort

We have no estimate of the resources that were devoted to this pilot test; however, they were considerable. They represented extra time and work, in parallel with (and calling on the same resources as) preparation of standard budget justification materials; moreover, the agency was "feeling its way". Subsequent attempts would presumably proceed more smoothly, assuming the agency remained as enthusiastic, but we suspect that enthusiasm in telling its story would be closely tied to what the agency believed the probable results on the appropriation level to be; the first reduction might quickly dampen enthusiasm.

CBO participation is clearly limited to the pilot test phase by the extent of resources available to CBO, which is a small office. It would not be possible for CBO to prepare, oversee, or even review in detail a large number of ZBB submissions.

An important question is the resources available to the Appropriations Committee to review the ZBB submissions. Despite considerable effort, we know of no way to simplify or summarize ZBB materials in such a way that they can be dealt with quickly. A careful study of the documentation--including at least some of the more critical decision package writeups themselves--will reward the diligent reader with new insights. But that study is not easy. And there is nothing more frustrating to a bureaucrat than to labor overtime to produce a report which will not be read.

Process

This report has been prepared by CBO, at the specific request of the Appropriations Committee staff. That fact gives us some pause. CBO does not, in general, consider itself qualified to suggest alterations of priorities in matters of programmatic detail. Indeed, ZBB requires that such priorities be recommended by lower levels of management, and altered only by successively higher levels. CBO, of course, is required by law to be non-partisan, and thus cannot make recommendations on program content or level. Also, the decision packages themselves should be published along with any summary.

Finally, there is the question of the posture of the executive branch. This exercise was not cleared explicitly by the highest levels of EPA or by the Office of Management and Budget, as might be required for a more formal submission by the agency. As a result, this report is neither fish nor fowl, representing, rather, a joint staff effort. A question which must be addressed in the implementation is the willingness of the executive branch to, in effect, provide options --as well as a recommendation--to the Congress. There has, in the past, been no formal mechanism for providing such options; but, of course, the various Committees usually become aware of agency desires by other means.

Applicability of Results

How well would the results of this exercise predict the results of ZBB as applied in general? Comparison of the results of this exercise with those of the other pilot tests prompts several conclusions.

First, it is difficult to generalize from an experiment -- which is known by the participants to be a test and therefore prompts extraordinary performance--to a routine application. Certainly, agency enthusiasm could wane and level of management involvement could decline. Second, any application is sensitive to the account selected for zero-basing. These results would have little relevance to programs which deliver routine services, or which consist of a single research target, such as a space shuttle or the liquid metal fast breeder reactor.

Finally, the sheer mass of documentation and level of programmatic scrutiny involved in agency-wide and government-wide application of ZBB would alter the climate in ways which can only be conjectured at this stage.

These observations are preliminary, and based on the single pilot test reported here. CBO is considering a comprehensive report on the four pilot tests which should be able to draw some further generalizations.

STAFF DRAFT ANALYSIS

ENERGY RESEARCH AND DEVELOPMENT PROGRAMS OF THE
ENVIRONMENTAL PROTECTION AGENCY: A Pilot Test of Zero-
Base Budgeting in a Legislative Framework
Volume II
Appendices

Prepared by
Edward H. Rastatter

Natural Resources and Commerce Division

CONGRESSIONAL BUDGET OFFICE

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HEALTH AND ECOLOGICAL EFFECTS:Ecological Effects

Aquatic Effects
Marine Effects
Terrestrial Effects
Reclamation/Revegetation

Environmental Transport Processes

Atmospheric Transport and Transformation
Weather Modification
Aquatic Transport
Marine Transport
Groundwater Transport

Monitoring

Air Monitoring
Water Monitoring
Groundwater Monitoring
Surface Monitoring
Quality Assurance

Instrumentation

Air Instrumentation
Water Instrumentation
Remote Instrumentation

Health Effects

Hazardous Agent I.D.
Dose and Damage Indicators
Metabolism of Hazardous Agents
Evaluation of Hazards to Man
Damage/Repair/Recovery Processes

CONTROL TECHNOLOGY:

Energy Resource Extraction

Solid Fuel
Oil and Gas

Physical/Chemical Coal Cleaning

Flue Gas Cleaning

FGD
NO_x Control Technology
Fine Particulate and Hazardous Materials Control

Waste and Water Pollution Control (Including Thermal)

Direct Combustion

Fluidized Bed Combustion
Advanced Oil Processing

Advanced Technologies

Synthetic Fuels (coal)
Synthetic Fuels (non-coal)
Waste as Fuel
Advanced Power Cycles
Advanced Energy Systems
Industrial Energy Conservation

PROGRAM INTEGRATION:

Integrated Technology Assessment
Technical Support

<u>PROGRAM</u>	<u>COMPONENT</u>	<u>SUBCOMPONENT</u>	<u>ACTIVITY</u>
Energy/Environment	Control Technology	Fuel Processing	Synthetic Fuels/ Non-Coal

RESOURCE DISTRIBUTION BY AGENCY

<u>FY-1978 LOWEST LEVEL BUDGET</u>		<u>FIRST INCREMENT</u>	<u>ADDITIONAL INCREMENT</u>
EPA (IERL-CI)	\$1,110,000	\$400,000	\$200,000
TOTAL	\$1,110,000	TOTAL \$400,000	TOTAL \$200,000

STATEMENT OF PURPOSE

Various non-coal based synthetic fuel processes are under development. The environmental and health effects of producing and utilizing synthetic fuels from oil shale, biomass, etc., are not thoroughly understood. This activity will identify the probable environmental effects of such processes and then develop and demonstrate pollution control technology to allow appropriate environmental standards to be written, adequate pollution control methods to be specified, and commercialization of synthetic fuel processes to proceed at a maximum rate. The program will also develop the necessary methodology and technical data base on processes to assist regulatory authorities in monitoring emerging energy commercialization activities. The program will facilitate development of environmental protection technology, concurrent with process development, to accelerate commercialization.

USE OF OUTPUTS

Research results will be utilized by:

- Industries and utilities in developing design and operational specifications for utilization of synthetic fuels.
- Equipment designers and manufacturers in developing equipment to control pollution from production of synthetic fuels.
- Federal, State and local authorities in setting standards and developing guidelines for production and utilization of synthetic fuels from non-coal sources.

DESCRIPTION OF OUTPUTS FOR LOWEST BUDGET (\$1,110,000)

Rank No. 8

- Pollution control methods and devices will be tested on pilot-scale retorting of oil shale at:
 - Paraho (Anvil Points, Colorado) - surface retorting
 - ERDA or Occidental - in-situ retorting
- An assessment of the best available control technologies for the emerging oil shale industry will be completed.
- An Analytical Methods Manual for expected pollutants from the syn-fuel industry will be prepared.
- Analytical reports on non-coal synthetic fuel pollutant emissions and control technology assessment will be prepared for:
 - Preliminary Environmental Assessment of a Hydrogen Economy
 - Macro-Economic and Macro-Environmental Study of Biomass Fuel vs. Coal

OUTPUTS FROM THE FIRST INCREMENT (\$400,000)

Rank No. 23

- Will extend pollution control technology testing to include Union or Tosco II pilot plants in addition to those listed under the first item in Description of Outputs for Lowest Budget.

OUTPUT FROM ADDITIONAL INCREMENT (\$200,000)

Rank No. 36

- Will provide evaluation of the environmental impacts of both the Union Oil and Tosco II processes for oil shale.
 - Will produce a Manual of Practice on best available pollution control technologies for the synthetic fuel (non-coal) industries. This will be used by regulatory agencies to set standards and by individual companies to design pollution control equipment.
-

APPENDIX C

SPECIFIC OUTPUTS FOREGONE FROM \$10 MILLION REDUCTION
TO 1978 REQUEST

Appendix C can be used in the following manner: The increment for the first sub-task listed below (Metabolism of Hazardous Agents), would be the last to be cut out in the event of a \$10 million reduction in the EPA energy R & D account, using the agency's priorities. The resulting budget level would be \$86,416,000. Conversely, in the event of any reduction up to \$10 million, the increment for the last sub-task listed below (Quality Assurance) would be the first to be cut out. For any budget level in between the requested amount and \$86,416,000, the reader may find the particular level under "Cumulative Budget", and all outputs from that item to the end of the list would be foregone.

<u>SUB-TASK:</u> <u>Outputs</u>	<u>Incremental</u> <u>Amount (\$000)</u>	<u>Cumulative</u> <u>Budget (\$000)</u>
Metabolism of Hazardous Agents	500	86,416
- o Data necessary to model the manner and rate which organic vapors or organic materials absorbed on inhaled particulates, having a variety of levels of solubility in body fluids are transformed and transported to critical tissue components. - o Develop a model of the manner in which energy related organics (drinking water pollutants) are transformed and transported to critical tissue components.		
Wastes - as - fuel	1,200	86,916
- o A feasibility study of the multi-waste gasification/pyrolysis process will be completed....a very promising alternative to waste co-combustion at existing power plants will thus be evaluated for the benefit of the utility and petroleum refining industries. - o Bioconversion of waste materials to fuel (e.g., acid hydrolysis) will be evaluated to assess its probable technical, economic and environmental feasibility; this will provide the industrial chemicals and petrochemicals industries with information on potential waste-derived feedstocks and fuel-extendors. - o Evaluations of several innovative techniques for preparation of waste-as-fuel materials for conversion to energy (e.g., new shredding and classification methods) will be produced; the entire waste-to-energy technological area will benefit from this research. - o A fourth commercial-scale waste-as-fuel technology will be assessed providing the data for New Source Performance Standards.		
Synthetic Fuel (Shale)	400	88,116
o Will extend pollution control technology testing to include Union or Tosco II pilot plants in addition to the Anvil Points, Colorado and ERDA or Occidental Sites tested at a lower budget level.		

<u>SUB-TASK:</u> <u>Outputs</u>	<u>Incremental</u> <u>Amount (\$000)</u>	<u>Cumulative</u> <u>Budget (\$000)</u>
Advanced Energy Systems	300	88,516
- o Ground water in geothermal areas will be characterized prior to development of geothermal resources providing a monitoring baseline for ground water protection to be used by agencies charged with protecting ground water quality. - o Chemistry of geothermal fluids upon loss of temperature and pressure and mixing with ground water will be investigated, and will provide data for use in the design of geothermal brine disposal wells. These data will be used by industrial developers and Federal/State ground water protection agencies. - o Solar energy use will be demonstrated at an EPA facility to conserve conventional fuels and to promote this technology to private and industrial sectors as an environmentally attractive pollution control alternative.		
Damage/Repair/Recovery Processes	500	88,816
- o Industrial hygiene surveys for coal gasification and coal liquefaction facilities. - o Generation of a "criteria" document for recirculation of air. - o Recommended work practices documents for advanced fossil fuel production facilities. - o Improved models regarding damage and recovery processes in the respiratory and immune systems.		
Atmospheric Transport and Transformation	1,000	89,316
- o Identification of organic compounds formed in the atmosphere which are derived from primary emissions from advanced fossil fuel combustion and conversion processes (coal gasification, oil shale processing, etc.) - o Systematic field studies at approximately six advanced fossil fuel combustion and synthetic fuels pilot and demonstration plants will determine the precursor chemical constituents and range of physical and meteorological conditions which lead to the formation of hazardous organics in the atmosphere due to these technologies.		

SUB-TASK:
Outputs

Incremental Amount (\$000)	Cumulative Budget (\$000)
-------------------------------	------------------------------

This is to provide a basis for the control of such pollutants in commercial sized plants and to identify compounds and concentrations for which additional health related exposure studies need to be done.

- o Baseline studies on current levels of hazardous organics in areas where new combustion and synthetic fuels plants are planned. This is necessary now to document the actual contribution of planned facilities to atmospheric levels of such hazardous organics and is essential to future control decisions and potential standards development. At present, no adequate data baseline exists for the types of organics which constitute emissions from such energy technologies. Candidate study areas are in Ohio River Basin.

Integrated Technology Assessment	400	90,316
----------------------------------	-----	--------

- o Complete regional assessments: Western (1978), Appalachian (1979), Ohio basin (1979).
- o Complete national assessments: electric utility (1978), advanced coal systems (1979), oil imports (1980).
- o Expand scope of electric utility assessment to include (1) mining, processing and transportation, (2) water consumption and quality, and (3) fluidized bed combustion.
- o Maintain interagency program schedule.

The funding increment will be used to speed the completion of two regional studies and the advance coal system assessments. The electric utility study will be expanded to include all parts of the coal processing system and water use questions.

Waste and Water Pollution Control	1,133	90,726
-----------------------------------	-------	--------

- o Development of a porous dike intake structure for cooling systems will be initiated to reduce fish entrapment and entrainment of larvae and post-larvae, reducing the environmental impact of cooling systems (co-funded program). (25 percent)*

*Figure in parenthesis indicates percent completion of project with projected funding.

SUB-TASK:
Outputs

Incremental
Amount (\$000)

Cumulative
Budget (\$000)

- o Studies of waste heat utilization in future systems will be initiated to reduce environmental effects of thermal discharges and promote energy conservation. (25 percent)
- o Pilot demonstration of FGD waste disposal in a coal mine will be expanded to include a comparison of the environmental effects and economics of untreated versus chemically treated wastes (co-funded program). (65 percent)
- o Pilot demonstration of advanced techniques for dewatering FGD wastes to reduce the volume of wastes generated will be completed. (100 percent)
- o Case studies of site-specific factors to evolve a design approach for disposal of flue gas cleaning wastes will be initiated so that the best disposal method for a specific plant can be selected. (20 percent)
- o Pilot demonstration of water recycle/reuse techniques will be expanded to include the examination of additional options so that closer to optimum integrated water use arrangement can be determined. (65 percent)
- o Pilot demonstration of alternatives to chlorination for cooling system biofouling control will be expanded to two techniques (rather than a single approach); this should enhance the opportunity for establishment of several options. (20 percent)
- o Evaluation of ammonia as an intermediate fluid in the cooling circuit in a dry cooling tower will be initiated to enhance the use of dry cooling systems in water-scarce areas (co-funded program). (30 percent)

Air Instrumentation

300

91,859

- o Advanced sampling and analytical methods for research studies to accurately identify and measure the wide variety of organic vapors and aerosols associated with new energy technologies such as coal gasification and oil shale conversion at ambient air concentrations.

<u>SUB-TASK:</u>	<u>Incremental</u>	<u>Cumulative</u>
<u>Outputs</u>	<u>Amount (\$000)</u>	<u>Budget (\$000)</u>

Emphasis will be placed on potentially hazardous compounds formed in the atmosphere; this effort paces the level of sophistication which is possible in performing atmospheric transport and transformation studies associated with organics from these technologies.

- o A portable device for sampling multiple gases in occupational environments associated with energy production and fuel processing facilities. This device is geared to provide sensitive analyses of such gases at concentrations associated with occupational rather than environmental settings.

Water Instrumentation	300	92,159
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- o A comprehensive measurement methodology of associated sampling and analytical methods for hazardous organics in streams from new energy technologies. Emphasis will be on compounds which are potentially carcinogenic with low level, long term exposure. Furthermore, within these categories, organic compounds which are not relatively volatile cannot be measured adequately by existing analytical techniques. Therefore, the exploration of new analytical procedures will be involved in the development of such a comprehensive measurement methodology. These methods will be used for sampling and analyzing streams and bodies of water which will be subject to contamination, even at low levels, by new energy technology demonstrations and commercializing.
- o Sampling and analytical methods for crude oil contamination of marine and coastal waters associated with Outer Continental Shelf drilling.

Water Monitoring	280	92,459
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- o Initiation of water monitoring and the acquisition of an accurate, consistent water quality baseline data at key sites in areas of the Eastern half of the U. S., where additional coal mining development is planned, especially where associated with planned coal combustion and conversion facilities. This will include areas of Illinois, Ohio, Kentucky and Tennessee and involves investigations, sampling and analysis at approximately 200 sites in these states. Evaluation of long term water

SUB-TASK:
Outputs

Incremental Amount (\$000)	Cumulative Budget (\$000)
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quality trends at sites associated with developments in these areas will yield a relationship between the gradual degradation of water quality due to coal mining related pollution from present mining sites, and also the quantification of the degree of further degradation in water quality which would be caused by additional coal development in these areas.

Technical Support

800

92,739

- o Produce four executive summary reports on energy/environment and energy-related environmental R&D topics.
- o Produce documentation, on project-by-project level, of entire fiscal year 1977 Interagency Program. Provide the same for the entire industrial program.
- o Support energy/environment R&D information transfer with two EPA regions.

Synthetic Fuel (Coal)

1,788

93,539

- o Increase Environmental Assessment Program for High BTU Gasification Process (will bring project to 25 percent completion). The incremental output will be used by regulatory agencies to address the new technologies, by environmental effects groups to determine differences from older technology and by development groups to ascertain the relative advantages or disadvantages of the technology and its merit of pursuit.
- o Initiate New Control Evaluation, Development for Gas Treatment (bring to 10 percent completion). The incremental output will be used by EPA to have controls available for attainment or improvement of ambient air quality, by EPA to protect the public health and welfare, by industry to seed their development of needed controls, and by regulatory agencies as options; e.g., tradeoffs on prevention of significant deterioration.
- o Initiate New Control Evaluation/Development for Water and Solids Waste Treatment (brings to 10 percent completion). The incremental output will be used by regulatory agencies to establish more cost effective alternatives, by health and ecological groups especially in long term and water effects.

<u>SUB-TASK</u> <u>Outputs</u>	<u>Incremental</u> <u>Amount (\$000)</u>	<u>Cumulative</u> <u>Budget (\$000)</u>
o Initiate New Control Evaluation/Development for Product/By-Product Treatment (brings to 10 percent completion). The incremental output will be used by regulatory agencies, by industry to allow utilization of otherwise unacceptable materials, by industry as seed to indicate the benefits of private process control development, and by ERDA for decision making by evaluation of marketability of by-products which would affect the main product's competitiveness.		
Oil and Gas Extraction	500	95,327
- o An environmentally acceptable pollution control method for the treatment of oily waste discharges from offshore oil and gas production facilities will be selected, evaluated and demonstrated to the prototype scale. This treatment system will be used by the petroleum industry on existing and new production facilities to meet the best available technology effluent guideline requirements. - o Initial evaluations of alternative oil spill prevention techniques for tank farms will be completed. These techniques will be used by the petroleum industry to meet the Oil Spill Prevention Regulation requirements. - o Five commercial oil spill cleanup systems will be evaluated at OHMSETT. Information from this evaluation will be used by individuals responsible for oil spill response in determining equipment needs. - o Approximately ten chemical systems for shoreline protection and restoration will be evaluated. These systems will be used by those responsible for oil spill cleanup in responding to spill incidents.		
Industrial Energy Conservation	300	95,827
- o Determination of trade-off between energy extraction from hot stack gases and the adverse environmental effects of reduced plume temperatures; output would be used by both regulatory authorities and design engineers. - o Assessment of the potential for environmental benefits from industrial process use of energy conserving fluidized bed combustion; this output would be used by process development engineers and regulatory officials.		

<u>SUB-TASK</u>	<u>Incremental</u>	<u>Cumulative</u>
<u>Outputs</u>	<u>Amount (\$000)</u>	<u>Budget (\$000)</u>

- o Analysis of pollutant type and emission levels from new energy-efficient primary copper smelting procedures; output would be used by EPA in developing New Source Performance Standards.

Quality Assurance	300	96,127
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- o Measurements quality assurance support for existing monitoring activities in the Southeastern and Midwestern United States; thereby creating a minimum, consistent, accurate regional baseline network where fossil fuel combustion and conversion plants are planned; this will provide a basis for subsequent regional air quality degradation studies. This support involves providing consistent sampling guidelines, instrumentation, calibration using reference materials relatable to national standards, laboratory cross-check analyses and evaluation of analytical laboratory performance. Without such quality control, the results from different monitoring stations will vary widely due to use of varying sampling and analysis methods among other factors. With quality control an array of sampling stations can produce intercomparable data, thereby producing an accurate air or water quality baseline over a broad region instead of sets of unrelatable data. The array of stations can then be truly classified as a regional network. This effort will involve EPA, TVA and USGS monitoring activities in energy intensive areas of the regions noted.
- o National standard reference materials needed for accurate calibration of instruments measuring organic water pollutants associated with coal gasification.

APPENDIX D

SPECIFIC OUTPUTS PRODUCED FROM \$10 MILLION ADDITION
TO 1978 REQUEST

Appendix D can be used in the following manner: if an additional amount over the 1978 request is appropriated for the EPA energy R & D account, the first \$714,000 would be applied to an expanded effort in the first sub-task listed below (Fluidized Bed Combustion). The outputs listed for the increment for that sub-task would be produced. If a full \$10 million were added, the last sub-task listed (Nitrous Oxide Control) would be expanded. For any addition to the request up to \$10 million, the reader may find the particular resulting budget level under "Cumulative Budget", and all outputs for the corresponding sub-task, and those preceding it, would be produced.

<u>SUB-TASK:</u> <u>Outputs</u>	<u>Incremental</u> <u>Amount (\$000)</u>	<u>Cumulative</u> <u>Budget (\$000)</u>
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Fluidized Bed Combustion

714

97,141

- o Accelerate Environmental Assessment of Atmospheric FBC Systems. Results will be used by IERL to compare (on an accelerated basis) comprehensive emissions data with health/ecological effects goals, thus identifying the environmental impact of the process and control needs. Results will also expand the data base needed by the program offices for standards setting.
- o Accelerate Control Technology Development of Atmospheric FBC Systems. Will accelerate acquisition of data needed by: EPA program offices in developing standards; EPA enforcement personnel in enforcing standards; ERDA in assessing the combustion technology that they are developing; and users/process developers/control technology suppliers in industry.

Air Monitoring

1,000

98,141

- o Baseline monitoring and meteorological modeling study is aimed at providing valid ambient baseline and initial trends data in air quality and at determining character of regional transport phenomena for critical pollutants, sulfate and fine particulate aerosol for regions of the Southeast and Midwestern U.S. where major additions in fossil fuel power plants capacity is planned, this is to make possible the establishment of a relationship between regional air quality degradation and the construction of new fossil fuel plants, with a view toward altering siting plans and documenting viable regional sulfate control options. This is needed as a reference point from which to judge allowable air quality degradation and the associated limit on regional fossil fuel emissions. This will entail the initiation of sulfate and fine particulate sampling at up to 50 sites along trajectories where assessment studies have shown existing and especially planned fossil fuel facilities will tend to increase population exposures. These areas have been identified as having inadequate or no sulfate data base. Candidate areas involve sites in the Alabama, Georgia, Tennessee region and in the Texas, Oklahoma region.

Water Monitoring

800

98,941

- o Establishment of a comprehensive regional energy related water quality network and acquisition of baseline data for major rivers and key tributaries along which new coal mining, coal combustion and conversion activity are underway and planned in the Midwestern

SUB-TASK:
Outputs

Incremental
Amount (\$000) Cumulative
Budget (\$000)

and Southeastern U.S. This network will complement specific site analyses and existing stations by providing direct, sensitive measurements on a broad scale, regional basis for coal related pollutants in areas both near and distant to sources.

- o Evaluation of long term, wide-area regional water quality trends associated with regional energy development will yield a relationship between the gradual degradation of water quality due to coal mining, combustion and conversion related pollution from existing and planned coal related development. Without such a regional baseline geared to pollutants from mining and from anticipated coal combustion conversion activity, there will not be an accurate past reference point from which to measure the changes in water quality when planned energy developments become operational in these regions.

Integrated Technology Assessment	1,100	100,041
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- o Complete regional assessments: western (1978), Appalachian (1979), Ohio basin (1979).
- o Complete national assessments: electric utility (1978), advance coal system (1979), oil imports (1979).
- o Expand efforts to incorporate comments on regional and national studies to define issues for reanalysis, e.g. coal transportation and sulfur regulations, water consumption and "beneficial consumptive use."
- o Initiate an additional regional ITA study of either the Northeast or the Gulf Coast.
- o Expand interagency integrated assessment program to include a forum for review and evaluation of modeling techniques and data sources.

The resources of the second increment allow the integrated assessment program to assure the effective communication of the results of analysis and to re-evaluate specific questions raised by users. A part of this process would include a mechanism for comparing and evaluating energy policy models and data basis use by all Federal agencies.

Flue Gas Desulfurization	1,631	101,672
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- o An assessment of the capital/operating costs associated with primary regenerable and non-regenerable systems for a variety of industrial boiler sizes and types will be performed. The

Incremental Amount (\$000)	Cumulative Budget (\$000)
100	100
100	200
100	300
100	400
100	500
100	600
100	700
100	800
100	900
100	1000
100	1100
100	1200
100	1300
100	1400
100	1500
100	1600
100	1700
100	1800
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100	8800
100	8900
100	9000
100	9100
100	9200
100	9300
100	9400
100	9500
100	9600
100	9700
100	9800
100	9900
100	10000

- o A demonstration of combined coal cleaning and FGD technologies for control of sulfur dioxide (SO₂) from a utility power plant will be performed. These technologies, in combination, may enable most cost-effective and applicable regulatory and compliance strategies for meeting SO₂ standards. (The package is cost shared between FGD and coal cleaning and will complete 100 percent of Phase I of a four-phase program.

- o Initiate Combined FGD/Physical Coal Cleaning Demonstration (brings project to 20% completion). This demonstration would impact on regulatory and utilities groups defining an integrated technology which would improve control and reduce control costs. ERDA and FEA would be interested in the potential for utilization of the Eastern high sulfur coal reserves for power generation.

- o Develop Alternatives to Slurry Pond Disposal (brings project to 50% completion). Information from these studies would be used by EPA regulatory and water planning group to define programs and environmental effects. Technology would be useful to the coal industry as a means of increased recovery of coal and elimination of the slurry pond problem.

- | | | |
|------------------------------|-----|---------|
| Evaluation of Hazards to Man | 750 | 103,775 |
|------------------------------|-----|---------|

- 168

<u>SUB-TASK:</u> <u>Outputs</u>	<u>Incremental</u> <u>Amount (\$000)</u>	<u>Cumulative</u> <u>Budget (\$000)</u>
Damage/Repair/Recovery Processes	1,000	104,775
o Improved models of damage and repair processes occurring in biological molecules, most notably DNA, and amelioration procedures, e.g. utilization of chelating agents to remove the toxic agents from critical tissues.		
Nitrous Oxide Control	1,500	106,275
- o Expand Development of Combustion Control Technology for Utility and Large Industrial Boilers - perform long term tests of the effect of CM on corrosion for 3 types of NSPS utility boilers, quantifying corrosion rates with respect to the type and degree of CM. - data firmly supports EPA's OAQPS revised no standards development - results identify for EPA, utilities and equipment manufacturers any potential problems associated with use of CM technology (20% completion)		

APPENDIX E SPECIFIC OUTPUTS FOREGONE FROM A REDUCTION OF
\$4 MILLION FOR HEALTH AND ECOLOGICAL EFFECTS

SUB-TASK
Outputs

Incremental
Amount (\$000)

Quality Assurance

300

Measurements quality assurance support for existing monitoring activities in the Southeastern and Midwestern United States; thereby creating a minimum, consistent, accurate regional baseline network where fossil fuel combustion and conversion plants are planned; this will provide a basis for subsequent regional air quality degradation studies. This support involves providing consistent sampling guidelines, instrumentation, calibration using reference materials relatable to national standards, laboratory cross-check analyses and evaluation of analytical laboratory performance. Without such quality control, the results from different monitoring stations will vary widely due to use of varying sampling and analysis methods among other factors. With quality control an array of sampling stations can produce intercomparable data, thereby producing an accurate air or water quality baseline over a broad region instead of sets of unrelatable data. The array of stations can then be truly classified as a regional network. This effort will involve EPA, TVA and USGS monitoring activities in energy intensive areas of the regions noted.

- o National standard reference materials needed for accurate calibration of instruments measuring organic water pollutants associated with coal gasification.

Water Monitoring

280

- o Initiation of water monitoring and the acquisition of an accurate, consistent water quality baseline data at key sites in areas of the Eastern half of the U.S., where additional coal mining development is planned, especially where associated with planned coal combustion and conversion facilities. This will include areas of Illinois, Ohio, Kentucky and

Tennessee and involves investigations, sampling and analysis at approximately 200 sites in these states. Evaluation of long-term water quality trends at sites associated with developments in these areas will yield a relationship between the gradual degradation of water quality due to coal mining related pollution from present mining sites, and also the quantification of the degree of further degradation in water quality which would be caused by additional coal development in these areas.

SUB-TASK
Outputs

Incremental
Amount (\$000)

Water Instrumentation

300

- o A comprehensive measurement methodology of associated sampling and analytical methods for hazardous organics in streams from new energy technologies. Emphasis will be on compounds which are potentially carcinogenic with low level, long-term exposure. Furthermore, within these categories, organic compounds which are not relatively volatile cannot be measured adequately by existing analytical techniques. Therefore, the exploration of new analytical procedures will be involved in the development of such a comprehensive measurement methodology. These methods will be used for sampling and analyzing streams and bodies of water which will be subject to contamination, even at low levels, by new energy technology demonstrations and commercializing.
- o Sampling and analytical methods for crude oil contamination of marine and coastal waters associated with Outer Continental Shelf drilling.

Air Instrumentation

300

- o Advanced sampling and analytical methods for research studies to accurately identify and measure the wide variety of organic vapors and aerosols associated with new energy technologies such as coal gasification and oil shale conversion at ambient air concentrations.

- o Initiate New Control Evaluation/Development for Product/By-Product Treatment (brings to 10 percent completion). The incremental output will be used by regulatory agencies, by industry to allow utilization of otherwise unacceptable materials, by industry as seed to indicate the benefits of private process control development, and by ERDA for decision making by evaluation of marketability of by-products which would affect the main product's competitiveness.

SUB-TASK
Outputs

Incremental
Amount (\$000)

Atmospheric Transport and Transformation 1,000

- o Identification of organic compounds formed in the atmosphere which are derived from primary emissions from advanced fossil fuel combustion and conversion processes (coal gasification, oil shale processing, etc.).
- o Systematic field studies at approximately six advanced fossil fuel combustion and synthetic fuels pilot and demonstration plants will determine the precursor chemical constituents and range of physical and meteorological conditions which lead to the formation of hazardous organics in the atmosphere due to these technologies.

This is to provide a basis for the control of such pollutants in commercial sized plants and to identify compounds and concentrations for which additional health related exposure studies need to be done.

- o Baseline studies on current levels of hazardous organics in areas where new combustion and synthetic fuels plants are planned. This is necessary now to document the actual contribution of planned facilities to atmospheric levels of such hazardous organics and is essential to future control decisions and potential standards development. At present, no adequate data baseline exists for the types of organics which constitute emissions from such energy technologies. Candidate study areas are in Ohio River Basin.

SUB-TASK
Outputs

Incremental
Amount (\$000)

Damage/Repair/Recovery Processes

500

- o Industrial hygiene surveys for coal gasification and coal liquefaction facilities.
- o Generation of a "criteria" document for recirculation of air.
- o Recommended work practices documents for advanced fossil fuel production facilities.
- o Improved models regarding damage and recovery processes in the respiratory and immune systems.

Metabolism of Hazardous Agents

500

- o Data necessary to model the manner and rate which organic vapors or organic materials absorbed on inhaled particulates, having a variety or levels of solubility in body fluids are transformed and transported to critical tissue components.
- o Develop a model of the manner in which energy related organics (drinking water pollutants) are transformed and transported to critical tissue components.

Dose and Damage Indicators

500,000

- o Preliminary development of a validated screening method which can yield early indications of sublethal repairable damage and which can be used in conjunction with human studies (clinical and/or epidemiological) e.g., detection of modification of learned behavior.

Weather Modification

135,000

- o A working model and workbook for predicting weather modification effects from cooling tower plumes and the interaction of cooling tower and power plant plumes. The output will include an assessment of longer range regional effects which might occur from source intensification such as power parks.

This work will be completed with fiscal year 1978 funds.

SECTION IV - OEMI PRIORITY OF PROGRAM INCREMENTS
WITHIN THE RANGE OF PLUS AND MINUS
\$10 MILLION

RELATIVE PRIORITY OF PROGRAM INCREMENTS WITHIN THE
RANGE OF PLUS AND MINUS \$10 MILLION FROM THE
\$96.4 MILLION PROGRAM

Priority Ranking 1st Increment	(\$M)	Priority Ranking 2nd Increment	(\$M)
A 35HE Metab. of Haz. Agents	.5	Q 29CT Fluid Bed	.7
B 22CT Waste-as-Fuel	1.2	R 42HE Air Mon.	1.0
C 23CT Syn. Fuel (Shale)	.4	S 43HE Wat. Mon.	1.0
D 24CT Adv. Eng. Sys.	.3	T 5PI Int. Tech. Ass.	1.1
E 36HE Damage/Repair	.5	U 30CT Flue Gas Desulf.	1.6
F 37HE Atmos. Transport	1.0	V 31CT Coal Clean	1.4
G 3PI Int. Tech. Asses.	.4	W 44HE Hazards to Man	.8
H 25CT Waste & Water	1.1	X 45HE Damage/Repair	1.0
I 38HE Air Instr.	.3	Y 32CT NO _x Control	1.5
J 39HE Water Instr.	.3		
K 40HE Water Mon.	.3		10.0
L 4PI Tech. Support	.8		
M 26CT Syn. Fuel (Coal)	1.8		
N 27CT Oil & Gas Ext.	.5		
O 28CT Ind. Conserv.	.3		
P 41HE Qual. Assur.	.3		
	10.0		

SECTION III - PROBLEM DEFINITION OR LONG-TERM RESEARCH
PRIORITIES WITHIN THE RANGE OF PLUS AND
MINUS \$10 MILLION

ENERGY/ENVIRONMENT SUBPROGRAM DECISION ACTIVITY

CROSS RANKING

		Health and Environmental Effects		
		(\$,M)		
Control Technology				
	(\$,M)			
+\$10M-----	34 Fine Part.	1.97	49 Aq. Eff.	1.0
	33 Solid Fuel	-1.11	48 Mar. Eff.	1.0
	32 NO _x	1.5	47 Dose & Dam.	.5
	31 Coal Clean.	1.35	46 Met. Haz. Ag.	.75
	30 FGD	1.63	45 Dam. Rep.	1.0
First Increment Budget \$96.4M	29 FBC	.71	44 Haz. to Man	1.0
	28 Ind. Con.	.3	43 Water Mon.	.8
	27 Oil & Gas	.5	42 Air Mon.	1.0
	26 Syn. Fuel, Coal	1.8	41 Q.A.	.3
	25 W&W	1.1	40 Water Mon.	.3
	24 Adv. Syn.	.3	39 Water Inst.	.3
	23 Syn. Fuel	.4	38 Air Inst.	.3
	22 Waste Fuel	-1.2	37 Air Trans.	1.0
	21 Coal Clean.	.3	36 Dam. Rep.	.5
			35 Met. of Haz.	.5
		34 Dose Dam.	.5	
		33 W. Mod.	.1	
		32 G.W. Mon.	.4	
		Program Integration		
		(\$,M)		
		5	1.1	
		4	.8	
		3	.4	
		ITB		

RELATIVE PRIORITY OF PROGRAM INCREMENTS WITHIN THE
RANGE OF PLUS AND MINUS \$10 MILLION FROM THE
\$96.4 MILLION PROGRAM STRESSING LONG-TERM
PROBLEM DEFINITION RESEARCH

Priority Ranking 1st Increment	(\$M)	Priority Ranking 2nd Increment	(\$M)
A 35HE Metab. of Haz. Agents	.5	Q 44HE Hazards to Man	.8
B 36HE Damage/Repair	.5	R 45HE Damage/Repair	1.0
C 37HE Atmos. Transport	1.0	S 29CT Fluid Bed	.7
D 24CT Adv. Eng. Sys.	.3	T 31CT Coal Clean	1.4
E 23CT Syn. Fuel (Shale)	.4	U 42HE Air Mon.	1.0
F 26CT Syn. Fuel (Coal)	1.8	V 43HE Wat. Mon.	1.0
G 3PI Int. Tech. Asses.	.4	W 5PI Int. Tech. Asses.	1.1
H 22CT Waste-as-Fuel	1.2	X 32CT NO _x Control	1.5
I 25CT Waste & Water	1.1	Y 30CT Flue Gas Desulf.	1.6
J 27CT Oil & Gas Extraction	.5		
K 28CT Ind. Conserv.	.3		10.0
L 4PI Tech. Support	.8		
M 38HE Air Instr.	.3		
N 39HE Water Instr.	.3		
O 40HE Water Mon.	.3		
P 41HE Qual. Assur.	.3		
	10.3		

NOTE: This ranking differs from the preceding ranking in that long-term problem definition research is more given priority over research designed primarily to meet short-term legislated mandates.